DEPARTMENT OF APPLIED STATISTICS,
UNIVERSITY OF LONDON, UNIVERSITY COLLEGE

DRAPERS' COMPANY RESEARCH MEMOIRS

STUDIES IN NATIONAL DETERIORATION. IV.

ON THE RELATIONSHIP OF HEALTH TO THE PSYCHICAL AND PHYSICAL CHARACTERS IN SCHOOL CHILDREN

BY
KARL PEARSON, F.R.S.

CAMBRIDGE UNIVERSITY PRESS
C. F. CLAY, MANAGER
LONDON: FETTER LANE, E.C. 4
ALSO
H. K. LEWIS & CO., LTD., 136, Gower Street, London, W.C. 1
WHELDON & WESLEY, LTD., 2–4, Arthur Street, New Oxford Street, W.C. 2
Bombay, Calcutta, Madras: Macmillan & Co., Limited
Tokyo: The Maruzen-Kabushiki-Kaisha
1923

Price Fifteen Shillings

The Cambridge University Press, Fetter Lane, London, E.C. 4, and their Agents, are now the sole Agents for the sale of the following publications of the Biometric and Galton Laboratories, University of London.

EUGENICS LABORATORY PUBLICATIONS.

Memoir Series.

I. **The Inheritance of Ability.** By Edgar Schuster, D.Sc., Formerly Galton Research Fellow, and Ethel M. Elderton, Galton Scholar. *Price* 8*s. net.* Sold only with complete sets.

II. **A First Study of the Statistics of Insanity and the Inheritance of the Insane Diathesis.** By David Heron, D.Sc., Formerly Galton Research Fellow. *Price* 8*s. net.* Sold only with complete sets.

III. **The Promise of Youth and the Performance of Manhood.** By Edgar Schuster, D.Sc., Formerly Galton Research Fellow. *Price* 8*s. net.* Sold only with complete sets.

IV. **On the Measure of the Resemblance of First Cousins.** By Ethel M. Elderton, Galton Research Fellow, assisted by Karl Pearson, F.R.S. *Price* 5*s. net.*

V. **A First Study of the Inheritance of Vision and of the Relative Influence of Heredity and Environment on Sight.** By Amy Barrington and Karl Pearson, F.R.S. *Price* 5*s. net.*

VI. **Treasury of Human Inheritance (Pedigrees of physical, psychical, and pathological Characters in Man).** Parts I and II (double part). (Diabetes insipidus, Split-Foot, Polydactylism, Brachydactylism, Tuberculosis, Deaf-Mutism, and Legal Ability.) *Price* 14*s. net.*

VII. **On the Relationship of Condition of the Teeth in Children to Factors of Health and Home Environment.** By E. C. Rhodes. *Price* 9*s. net.*

VIII. **The Influence of Unfavourable Home Environment and Defective Physique on the Intelligence of School Children.** By David Heron, M.A., D.Sc., Formerly Galton Research Fellow. *Price* 8*s. net.* Sold only with complete sets.

IX. **The Treasury of Human Inheritance (Pedigrees of physical, psychical, and pathological Characters in Man).** Part III. (Angioneurotic Oedema, Hermaphroditism, Deaf-Mutism, Insanity, Commercial Ability.) *Price* 10*s. net.*

X. **The Influence of Parental Alcoholism on the Physique and Intelligence of the Offspring.** By Ethel M. Elderton, assisted by Karl Pearson. *Second Edition. Price* 6*s. net.*

XI. **The Treasury of Human Inheritance (Pedigrees of physical, psychical, and pathological Characters in Man).** Part IV. (Cleft Palate, Hare-Lip, Deaf-Mutism, and Congenital Cataract.) *Price* 10*s. net.*

XII. **The Treasury of Human Inheritance (Pedigrees of physical, psychical, and pathological Characters in Man).** Parts V and VI. (Haemophilia.) *Price* 15*s. net.*

XIII. **A Second Study of the Influence of Parental Alcoholism on the Physique and Intelligence of the Offspring.** By Karl Pearson, F.R.S., and Ethel M. Elderton. *Price* 6*s. net.*

XIV. **A Preliminary Study of Extreme Alcoholism in Adults.** By Amy Barrington and Karl Pearson, F.R.S., assisted by David Heron, D.Sc. *Price* 6*s. net.*

XV. **The Treasury of Human Inheritance.** Dwarfism, with 49 Plates of Illustrations and 8 Plates of Pedigrees. *Price* 15*s. net.*

XVI. **The Treasury of Human Inheritance.** Prefatory matter and indices to Vol. I. With Frontispiece Portraits of Sir Francis Galton and Ancestry. *Price* 5*s. net.*

XVII. **A Second Study of Extreme Alcoholism in Adults.** With special reference to the Home-Office Inebriate Reformatory data. By David Heron, D.Sc. *Price* 6*s. net.*

XVIII. **On the Correlation of Fertility with Social Value.** A Cooperative Study. *Price* 7*s.* 6*d. net.*

XIX—XX. **Report on the English Birthrate.** Part I. England, North of the Humber. By Ethel M. Elderton, Galton Research Fellow. *Price* 9*s. net.*

XXI. **Treasury of Human Inheritance.** Nettleship Memorial Volume. Heredity of Eye Anomalies and Diseases. Part I. *Price* 45*s. net.*

Vol. I of *The Treasury of Human Inheritance* (VI + IX + XI + XII + XV + XVI of the above memoirs) may be obtained in wrappers, price 60*s. net.* Buckram cases for binding can be purchased with impress of the bust of Sir Francis Galton. An engraved portrait of Sir Francis Galton can be obtained by sending a postal order for 3*s.* 6*d.* to the Secretary to the Laboratory, University College, London, W.C.

Lecture Series.

I. **The Scope and Importance to the State of the Science of National Eugenics.** By Karl Pearson, F.R.S. Third Edition. *Price* 1*s.* 6*d. net.*

II. **The Groundwork of Eugenics.** By Karl Pearson, F.R.S. Second Edition. *Price* 1*s.* 6*d. net.*

III. **The Relative Strength of Nurture and Nature.** Much enlarged Second Edition. Part I. The Relative Strength of Nurture and Nature. (Second Edition revised.) By Ethel M. Elderton. Part II. Some Recent Misinterpretations of the Problem of Nurture and Nature. (First Issue.) By Karl Pearson, F.R.S. *Price* 2*s.* 6*d. net.*

IV. **On the Marriage of First Cousins.** By Ethel M. Elderton. *Price* 1*s.* 6*d. net.*

V. **The Problem of Practical Eugenics.** By Karl Pearson, F.R.S. Second Edition. *Price* 1*s.* 6*d. net.*

VI. **Nature and Nurture, the Problem of the Future.** By Karl Pearson, F.R.S. Second Edition. *Price* 1*s.* 6*d. net.*

VII. **The Academic Aspect of the Science of National Eugenics.** By Karl Pearson, F.R.S. *Price* 1*s.* 6*d. net.*

VIII. **Tuberculosis, Heredity and Environment.** By Karl Pearson, F.R.S. *Price* 1*s.* 6*d. net.*

IX. **Darwinism, Medical Progress and Eugenics.** The Cavendish Lecture, 1912. By Karl Pearson, F.R.S. *Price* 1*s.* 6*d. net.*

X. **The Handicapping of the First-born.** By Karl Pearson, F.R.S. *Price* 2*s.* 6*d. net.*

XI. **National Life from the Standpoint of Science.** (Third Issue.) By Karl Pearson, F.R.S. *Price* 1*s.* 6*d. net.*

XII. **The Function of Science in the Modern State.** (New Issue.) By Karl Pearson, F.R.S. *Price* 2*s. net.*

XIII. **Side Lights on the Evolution of Man.** By Karl Pearson, F.R.S. *Price* 3*s. net.*

Noteworthy Families. By Francis Galton, F.R.S. and Edgar Schuster. (*Reissue.*) *Price* 9*s. net.*

Life History Album. By Francis Galton, F.R.S. *Second Edition.* (*New Issue.*) *Price* 12*s. net.*

DEPARTMENT OF APPLIED STATISTICS,
UNIVERSITY OF LONDON, UNIVERSITY COLLEGE

DRAPERS' COMPANY RESEARCH MEMOIRS

STUDIES IN NATIONAL DETERIORATION. IV.

ON THE RELATIONSHIP OF HEALTH TO THE PSYCHICAL AND PHYSICAL CHARACTERS IN SCHOOL CHILDREN

BY
KARL PEARSON, F.R.S.

> General impressions are never to be trusted. Unfortunately when they are of long standing they become fixed rules of life, and assume a prescriptive right not to be questioned. Consequently, those who are not accustomed to original inquiry entertain a hatred and a horror of statistics. They cannot endure the idea of submitting their sacred impressions to cold-blooded verification. But it is the triumph of scientific men to rise superior to such superstitions, to devise tests by which the value of beliefs may be ascertained, and to feel sufficiently masters of themselves to discard contemptuously whatever may be found untrue.—FRANCIS GALTON.

CAMBRIDGE
AT THE UNIVERSITY PRESS
1923

CONTENTS

	PAGE	DIAGRAMS
1. INTRODUCTION	3	
2. SCALES OF HEALTH AND RELATION OF HEALTH TO AGE	4	I^{a-b}, p. 6
3. INTELLIGENCE AND AGE. PSYCHICAL CHARACTERS AND AGE	7	II^{a-b}, III, pp. 8, 9
(*a*) Conscientiousness and Age	9	IV^{a-b}, p. 10
(*b*) Self-consciousness and Age	11	V^{a-b}, p. 12
(*c*) Shyness and Age	11	VI^{a-b}, p. 13
(*d*) Temper and Age	14	VII, VIII^{a-b}, pp. 14, 15
(*e*) Vivacity and Age	14	IX^{a-b}, p. 16
(*f*) Handwriting and Age	17	X^{a-b}, p. 18
(*g*) Athletic Power and Age	19	XI, XII^{a-b}, pp. 20, 21
4. PSYCHICAL CHARACTERS OF THE ATHLETIC; THE ATHLETIC CHILD NEITHER OAF NOR FOOL	20	XIII^{a-b}—XX^{a-b}, pp. 23–32
5. (*h*) POPULARITY AND AGE	31	XXI^{a-b}, p. 33
6. RELATION OF POPULARITY TO PSYCHICAL AND PHYSICAL CHARACTERISTICS OF THE CHILD	34	XXII^{a-b}—XXIX^{a-b}, pp. 35–45
7. CORRELATIONS INDICATING HOW SMALL IS THE INFLUENCE OF GROWTH AND EDUCATION ON THE PSYCHICAL CHARACTERS	43	——
8. INFLUENCE OF HEALTH ON THE PSYCHICAL AND PHYSICAL CHARACTERS	44	——
(*a*) Health and Intelligence	44	XXX^{a-b}, XXXI, pp. 46, 47
(*b*) Health and Conscientiousness	48	XXXII^{a-b}, p. 49
(*c*) Health and Self-consciousness	48	XXXIII^{a-b}, p. 50
(*d*) Health and Shyness	48	XXXIV^{a-b}, p. 51
(*e*) Health and Popularity	48	XXVII^{a-b}, p. 41
(*f*) Health and Vivacity	54	XXXV^{a-b}, p. 52
(*g*) Health and Temper	54	XXXVI^{a-b}, XXXVII, pp. 53, 54
(*h*) Health and Handwriting	55	XXXVIII^{a-b}, p. 56
(*i*) Health and Athletics	55	XXXIX^{a-b}, p. 57
9. HEALTH AND EXTERNAL STATICAL ANTHROPOMETRIC CHARACTERS	55	No Diagrams
(*a*) Health and Hair colour	55	
(*b*) Health and Set of Hair	55	
(*c*) Health and Eye colour	55	
(*d*) Health and Size and Shape of Head	58	
Summary of relation of Health to Statical Characters	58	
10. GENERAL DISCUSSION OF THE RELATION OF HEALTH TO THE PSYCHICAL CHARACTERS	59	——
11. CRITICISM OF THREE WIDELY ACCEPTED BELIEFS	60	——
12. CONCLUSION, NOTE ON ORIGIN OF PRESENT MEMOIR	62	——
APPENDIX, TABLES OF DATA	63	——

On the Relationship of Health to the Psychical and Physical Characters of School Children.

BY KARL PEARSON, F.R.S.

(1) *Introduction.* The present investigation is one I hold to be of some importance. It is not infrequently assumed that a close relation exists between the health of children and their intelligence, or more generally between their health and their psychical characters. It is supposed that shyness, self-consciousness and even conscientiousness are peculiarly related to weak or delicate physique. I propose in this paper to test these suppositions by providing numerical measures of the actual associations. I shall consider further whether, and if so, to what extent, health is related to the more obvious and usual anthropometric characters of children. That health is an hereditary character has been shown not only by the correlations between the health of non-adult brothers and sisters, but also by the correlations between parents and adult children[*]. Within the range of school ages, 4 to 19 years, we shall show that there is very little association between health and age. Within the same range of years we find there is no relationship between age and general intelligence, if the latter be a true measure of capacity and not of acquired knowledge[†]. If we should come to the conclusion that the external physical characters as hitherto measured are not in the least adequate as a guide to the psychical, if we find that health is not significantly related to intelligence, and that both these characters are markedly hereditary, we must not rush to the conclusions that health cannot be modified—within limits—by environment, or that acquired knowledge and training are not essential to the outfit of the highest intelligence in practical life. When we assert that health and intelligence are hereditary we intend to disfranchise neither the doctor, nor the teacher. After all the metal of your chisel or your carving knife is good or bad steel. You will need to harden, and temper and grind your chisel if you wish to make it efficient for its task; but that does not get over the truth that no amount of such treatment will permanently convert bad steel into good steel. Poor metal loses its edge at once in the wear and tear of life's workshop. While health and intelligence have little relation to age certain of the external characters change considerably with age. In order to avoid age difficulties, growth curves were formed for the anthropometric characters and all values reduced to the standard age of twelve.

Our material is adequate to reach definite results, if we are satisfied with its accuracy. Our tables give data for about 2000 boys and 2000 girls. For some characters we are able to deal with 2300 cases, for a few we have not more than 1700 instances. This is partly due to the non-entry of certain characters in certain schools, but more to the need of excluding certain individuals and even whole schools where we were aware of a difference of race.

---

[*] *Biometrika*, Vol. III. pp. 146, 154, and Vol. IX. pp. 320—329.

[†] *Biometrika*, Vol. V. pp. 114—115.

The material is one that I have often used in similar investigations, namely the school-data series I collected during the years 1898—1903 with the aid of picked school-masters and -mistresses. It has formed the basis of investigations into the heredity of mental and physical characters[*], and into the relation of intelligence to physical characters[†].

It has been tested in a variety of ways, especially as to the influence of the personal equation of the contributors[‡]. These are therefore questions which it does not seem needful to again turn to, nor need we cite for our present purposes the verbal definitions of the categories, which have been provided in earlier papers[§]. We shall therefore proceed at once to the main question as to the extent to which the general health of the school-child affects its temperament and mental characters.

(2) We shall first consider how far the health of the school-child is related to age. Our health categories were Very Robust, Robust, Normally Healthy, Rather Delicate and Very Delicate. We have 2388 boys ranging from 4 to 19 years of age, and 2290 girls from 4 to 18 years of age. The complete tables are given as Table I and Table II of Appendix. To obtain graphs of health to age we have reduced our data to three health categories, and concentrated the earliest and latest years at their means. Our data for health in boys and in girls have been reduced to a normal scale for the purpose of plotting graphs and they give the following systems, x being an abscissa and σ a standard deviation.

Ranges	Boys	Girls[‖]
Range of Very Robust ...	$x/\sigma = +\infty$ to 1·55	$+\infty$ to 1·56
Range of Robust	$x/\sigma =$ 1·55 to ·29	1·56 to ·36
Range of Normally Healthy ...	$x/\sigma =$ ·29 to − ·95	·36 to − ·69
Range of Rather Delicate ...	$x/\sigma = -$ ·95 to − 2·29	− ·69 to − 1·96
Range of Very Delicate ...	$x/\sigma = -$ 2·29 to $-\infty$	− 1·96 to $-\infty$

Means	Boys	Girls[‖]
Very Robust ...	$\bar{x}_1/\sigma = +$ 1·99	+ 1·99
Robust	$\bar{x}_2/\sigma = +$ ·81	+ ·85
Normally Healthy ...	$\bar{x}_3/\sigma = -$ ·29	− ·15
Rather Delicate ...	$\bar{x}_4/\sigma = -$ 1·41	− 1·12
Very Delicate ...	$\bar{x}_5/\sigma = -$ 2·63	− 2·34

---

[*] Huxley Lecture, *Biometrika*, Vol. III. p. 131 *et seq.*

[†] *Biometrika*, Vol. V. p. 105 *et seq.*

[‡] *Biometrika*, Vol. III. p. 147, and Vol. V. p. 474 *et seq.*

[§] *Biometrika*, Vol. III. pp. 161—162. See also Vol. VIII. p. 93.

[‖] By an oversight these results were deduced from a table of 2276 girls instead of the one for 2290 girls but this makes no difference for plotting purposes in the case of the graphs.

These scales[*] have been used throughout for the graphs, even if the total numbers dealt with in the categories differed somewhat. I consider them adequate for plotting purposes.

The following are the reduced tables referred to:

TABLES α AND β. *Age and Health.*

(α) Boys					(β) Girls				
Age	Robust	N. Healthy	Delicate	Totals	Age	Robust	N. Healthy	Delicate	Totals
6·008†	24	29	12	65	5·993†	29	25	13	67
7·5	33	36	20	89	7·5	26	35	19	80
8·5	57	68	30	155	8·5	42	45	30	117
9·5	76	84	37	197	9·5	72	72	43	187
10·5	88	105·5	47·5	241	10·5	83	95	50	228
11·5	133	124	43	300	11·5	104	107	66	277
12·5	107	156·5	44·5	308	12·5	112	117·5	67·5	297
13·5	123	147	63	333	13·5	92	114	69	275
14·5	94·5	107·5	41	243	14·5	77	83	51	211
15·5	69·5	96	31·5	197	15·5	66	85·5	60·5	212
16·5	57	57	18	132	16·5	58·5	58	47·5	164
17·5	29·5	33	11·5	74	17·5	32	33	29	94
18·741‡	28·5	19·5	6	54	18·5	31	31·5	18·5	81
Totals ...	920	1063	405	2388	Totals ...	824·5	901·5	564	2290

† Mean of groups 4·5, 5·5, 6·5. ‡ Mean of groups 18·5, 19·5.

Diagrams I^a and I^b (p. 6) give the regression lines of health on age and age on health for boys and girls respectively[§].

It is clear that there is a very small relationship between Health and Age. It is represented by:

	Boys	Girls
Correlation:	+ ·031 ± ·014	− ·035 ± ·014

and its smallness may be inferred from the diagrams. We may also consider the mean age and standard deviation for each category of health:

TABLE γ. *Mean Age and Standard Deviation for each Health Category.*

	Boys		Girls	
	Means	Standard Deviations	Means	Standard Deviations
Very Robust ...	12·64 ± ·19	3·07 ± ·13	12·83 ± ·19	3·18 ± ·13
Robust	12·46 ± ·07	2·88 ± ·05	12·51 ± ·08	2·99 ± ·05
Normally Healthy ...	12·44 ± ·06	2·80 ± ·04	12·61 ± ·07	2·95 ± ·05
Rather Delicate ...	12·15 ± ·10	2·88 ± ·07	12·89 ± ·09	3·02 ± ·06
Very Delicate ...	12·35 ± ·28	2·14 ± ·20	12·65 ± ·24	2·62 ± ·17
Whole Population ...	12·41 ± ·04	2·85 ± ·03	12·66 ± ·04	2·99 ± ·03

---

[*] The class-index correlations for health are Boys: ·9376, Girls: ·9406, and these have been used where requisite throughout.

[§] In all the diagrams throughout this memoir, the rectangle round the mean is that of the *doubled* standard deviations, and the unit of the scale is usually the tenth part of the standard deviation.

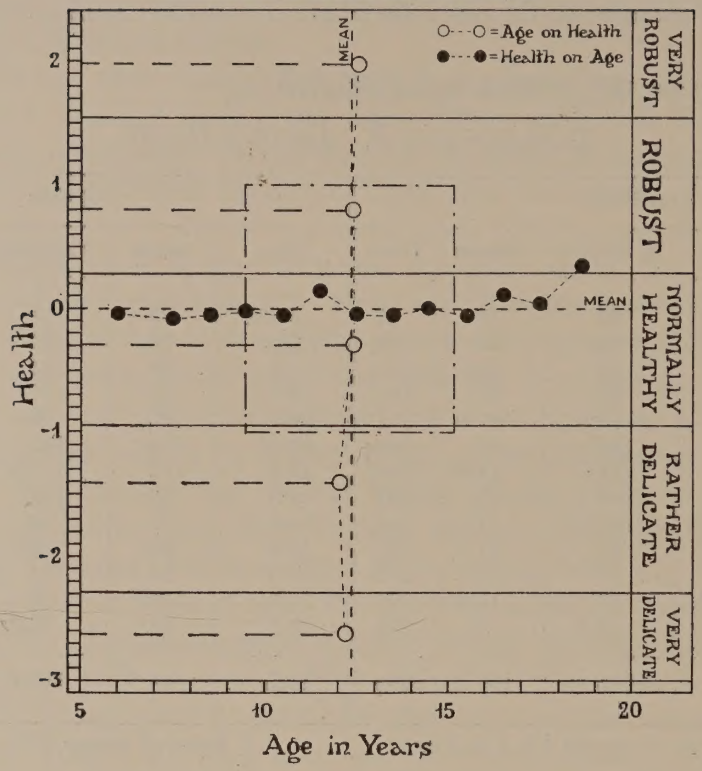
HEALTH & AGE. *Boys.*

Diagram I^a

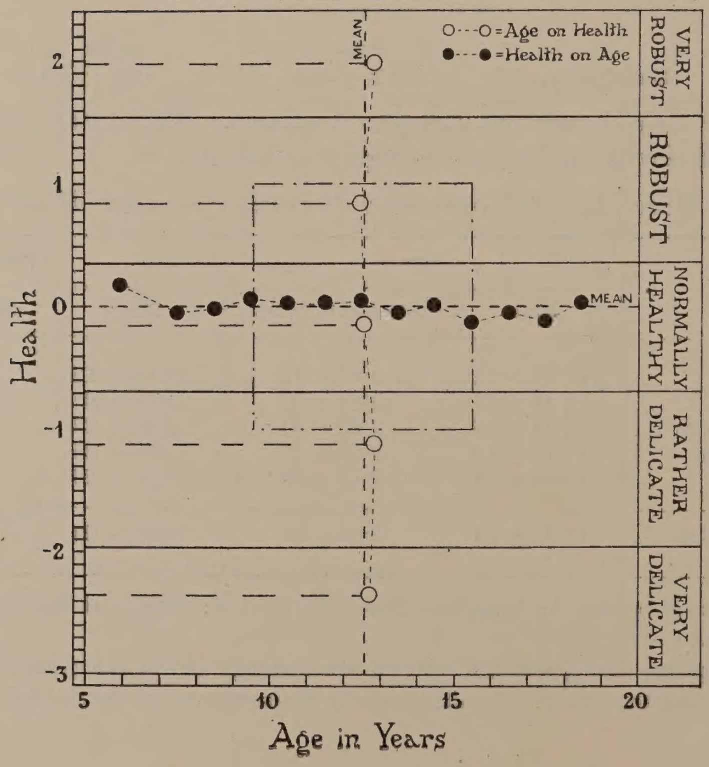
HEALTH & AGE. *Girls.*

Diagram I^b

Here the slight falling in mean age as we pass from Very Robust to Rather Delicate boys is not confirmed by the girls; it is conceivable that on-coming puberty in the girls has more influence on their health than it has on that of boys. Anyhow the relationship between age and health is very slight, and this applies in the main also to the standard deviations. The latter have, however, one feature common to Boys and Girls. While there is no sensible difference in the variability of Robust, Normally Healthy and Rather Delicate children, the Very Robust and the Very Delicate children show signs respectively of greater and of less variability in age. I think this denotes that Very Delicate children go late to school and leave—possibly owing to death—earlier; while Very Robust children go early and live to reach the higher school ages. The point is worth noting although it has no great importance for our immediate purpose.

Generally, however, we may lay it down that the age of a school-child has very little influence on its health. Thus *on the average* the health of a child of four will not be sensibly modified as it grows older. There has probably been much exaggeration about the idea that children grow stronger with age; it may be true of individual cases, but our data indicate that they must be fairly well balanced by individual children who grow less healthy as they grow older. We might even have anticipated that the dying of very delicate children would have produced an appreciable correlation between greater age and better health. This does not, however, appear to be the case. We conclude that it is unnecessary to correct health for age.

(3) We have already indicated that, while knowledge is correlated with age, intelligence properly measured is scarcely correlated at all with age. Our diagrams II^a and II^b (p. 8) are based on Tables III and IV of Appendix.

On the other hand head measurements are correlated with age; to some small extent hair colour in children is, and to a still less extent eye colour. Allowance for growth has been made in our head characters*, but not in the case of the far less important changes in hair and eye colour†.

We have still to ask, however, whether there is any substantial modification of the temperament of our children. The psychical characters we noted were:

(*a*) Conscientiousness: Keen, or Dull;
(*b*) Shy, or Self-assertive;
(*c*) Self-conscious, or Unself-conscious;
(*d*) Noisy, or Quiet (Vivacity);
(*e*) Temper in three categories: Quick, Good-natured, Sullen;
(*f*) Popular, or Unpopular;

where in the last category we must suppose, without specifying them, that certain temperamental characteristics such as sympathy, generosity, straightforwardness, etc., make for popularity in the school-world. Actually a third or intermediate class was formed between each pair of contrasted qualities which has proved occasionally of value in our statistical reductions. Where this intermediate class, usually a small one, is not

---

* *Biometrika*, Vol. III. p. 141. The reduction is to size at 12 years.

† See *Biometrika*, Vol. III. pp. 463—464 for present material.

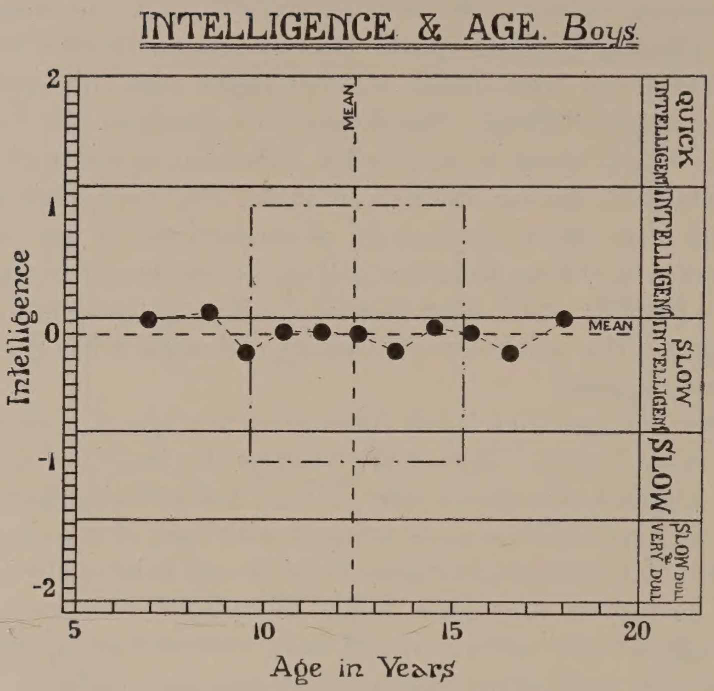

Diagram II^{a}

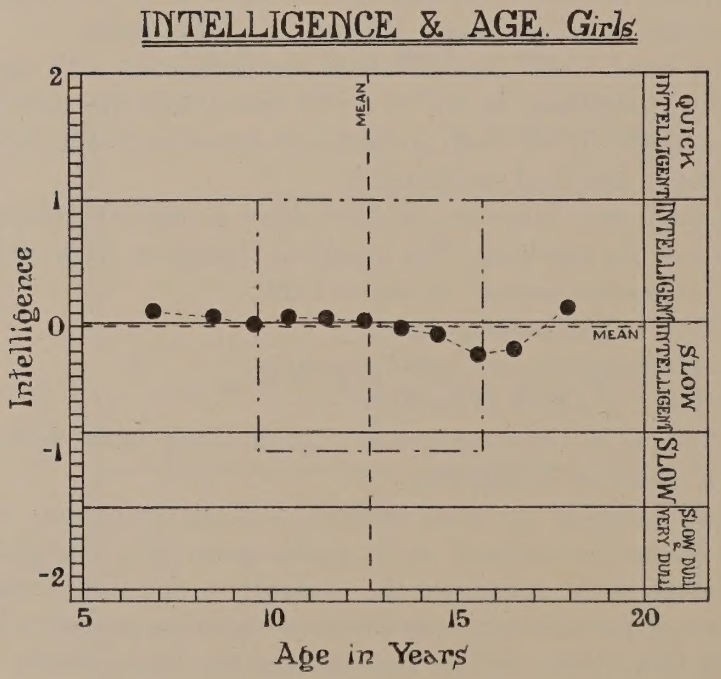

Diagram II^{b}

referred to in a table, it is to be understood that individuals classed in it have been placed half in the one, half in the other main category*.

The simplest method to ascertain whether our data indicate a change in these psychical characters with age would at first sight seem to be a determination of whether the proportions in the alternative categories are substantially modified by age. The accompanying table illustrates some of the results reached in this rather crude manner. The table gives the percentages in Quick Temper, Sullen Temper and Popularity with various ages for upwards of 2000 Boys used in the diagram.

PERCENTAGES OF CERTAIN PSYCHICAL CHARACTERS AT DIFFERENT AGES, 2,000 BOYS.

	Age in Years											
Percentages of	4-7	8	9	10	11	12	13	14	15	16	17-19	All
Quick Temper	18·3%	15·8%	17·2%	19·1%	23·7%	19·3%	18·2%	20·1%	15·4%	16·6%	19·7%	18·9%
Sullen Temper	15·5%	12·5%	13·2%	13·7%	12·2%	12·6%	14·0%	11·1%	14·2%	10·1%	11·5%	12·9%
Popularity	75·0%	65·4%	73·0%	69·0%	72·4%	69·4%	68·5%	69·5%	63·5%	66·7%	58·8%	68·9%

Diagram III

We might possibly conclude from this that the older boys are less popular than the younger and the younger boys more sullen than the older. But these inferences from percentages of such irregularity are very doubtful and, if a reality, are very probably only a passing effect of on-coming puberty. We must in such questions put aside percentages as too indefinite and endeavour to reach some measure of the grade of the psychical character associated with each age. We attain this end where the psychical character is given by a threefold division by assuming the array for a given age to be normal, and reducing the standard deviation of the array to that of the whole population on the basis of a common middle category†. We are thus able to exhibit a graph and calculate the correlation and the regression lines. We will take some of the psychical characters in order.

(*a*) *Conscientiousness and Age.*

Diagrams IV^a and IV^b (p. 10) give the plotted data for Boys and Girls respectively.

---

* Whenever a fourfold table has been used, then the intermediate or 'betwixt' class has been *halved* between the adjacent categories. It was obtained by asking the teachers, when no judgment could be made, to put their cross on the dividing rule of the schedule. It is possible that a child has occasionally been placed in the 'betwixt' category because the teacher was ignorant of his characteristics, but this was really excluded by the instructions. The instruction was given that the observer should have known *well* the child for at least six months and if possible for a much longer period. "What is needed is the general impression of a teacher who has carefully observed his or her pupils," and "If the alternative characteristics are possessed in a marked degree, place the cross on the dividing line."

† *Biometrika*, Vol. XIV. pp. 152—156.

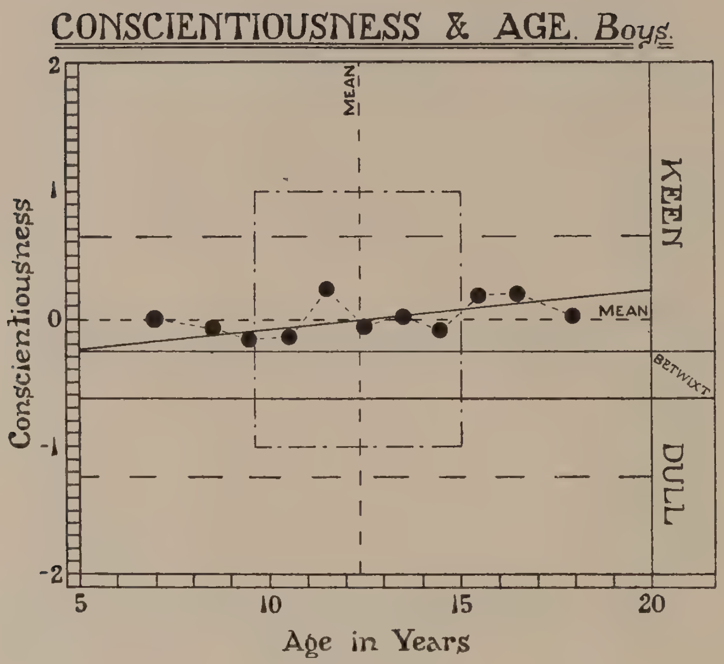

Diagram IV^a

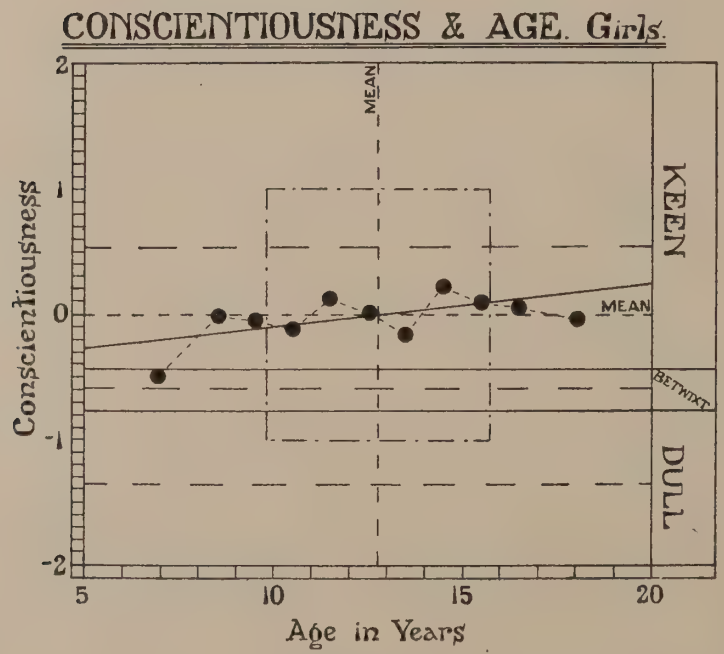

Diagram IV^b

The diagrams show us that there is hardly any change with age; the correlations from corrected tri-serial η (Tables IX and X of Appendix) are:

$$\text{Boys}: +0{\cdot}052 \pm {\cdot}015, \quad \text{Girls}: +0{\cdot}076 \pm {\cdot}015.$$

Taking the case of Boys the range of the category of children whom their teachers placed in the 'mid-class,' i.e. those to whom they could not attribute either keen or dull conscientiousness*, was $\cdot 3768\sigma$, or about a third of the standard deviation in conscientiousness. The total amount of the rise in conscientiousness in 15 years from 4 to 19 is $\cdot 3040\sigma$, or *less* than the range of the indifferent category. Thus the whole educational period of a child does not on the average suffice to transfer a child of dull conscientiousness to the category of keen conscientiousness. We are driven to the conclusion: that keen conscientiousness is not an educational product at all, for if it were the correlation between age and conscientiousness would be something reasonably substantial.

(*b*) I take next our measure of *Introspection*, namely *Self-consciousness and Age.*

The Diagrams V^a and V^b (p. 12) illustrate this.

The correlations from corrected tri-serial η (Tables XI and XII of Appendix) are:

$$\text{Boys}: +0{\cdot}054 \pm {\cdot}015, \quad \text{Girls}: +0{\cdot}028 \pm {\cdot}015;$$

these again are of the slenderest kind. From 4 to 19 years of age children of both sexes increase very slightly in self-consciousness, but on the average no child will be carried through a range equal to the middle category†. You cannot transfer a child from the Self-conscious to the Unself-conscious category by the whole course of school education from 4 to 19. Self-consciousness like Conscientiousness is an innate category untouched by education.

(*c*) We turn to *Shyness or Self-assertion and Age.*

The graphs are provided in Diagrams VI^a and VI^b (p. 13). We see that boys get very slightly more shy as they grow older. Girls on the contrary increase, though not very markedly, in self-assertion. On the average no boy during the whole range of school life will pass from the self-assertive to the shy category. On the other hand it is just possible for a girl to pass from the shyness of infancy to self-assertion in her later school years.

The correlations from corrected tri-serial η (Tables XIII and XIV of Appendix) are:

$$\text{Boys}: -0{\cdot}024 \pm {\cdot}015, \quad \text{Girls}: +0{\cdot}074 \pm {\cdot}015.$$

The fact that the psychical growth of boys and girls is in opposite senses in the case of shyness seems to rule out any influence of education in the matter. It undoubtedly suggests that the development is physiological and due to a difference associated with sex. The boy, if he alters at all, tends to be more shy in his hobble-de-hoy days, and the girl to be more conscious of her power of attraction. In other words the girl becomes a woman earlier than the boy becomes a man.

---

* The percentage of this mid-class was: 13·6 in boys and 11·2 in girls.

† Percentage of the mid-class = 10·7 in boys and 6·5 in girls.

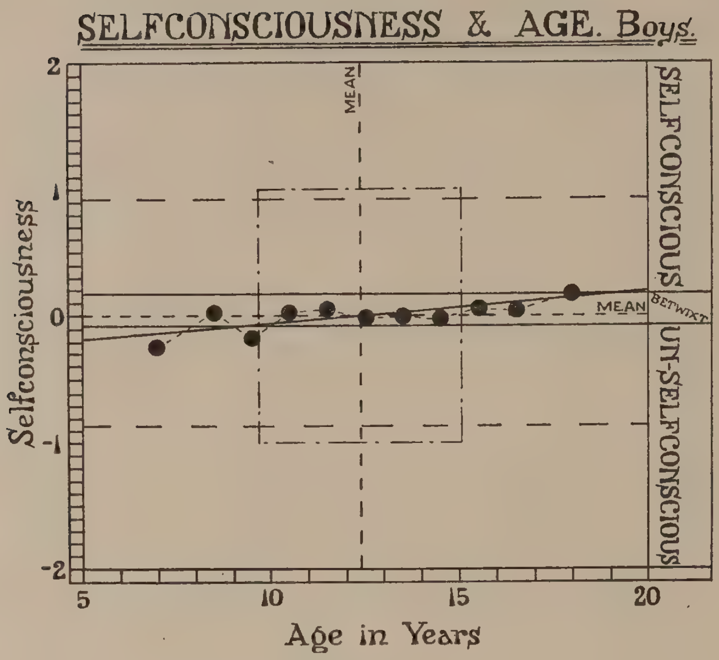

Diagram V

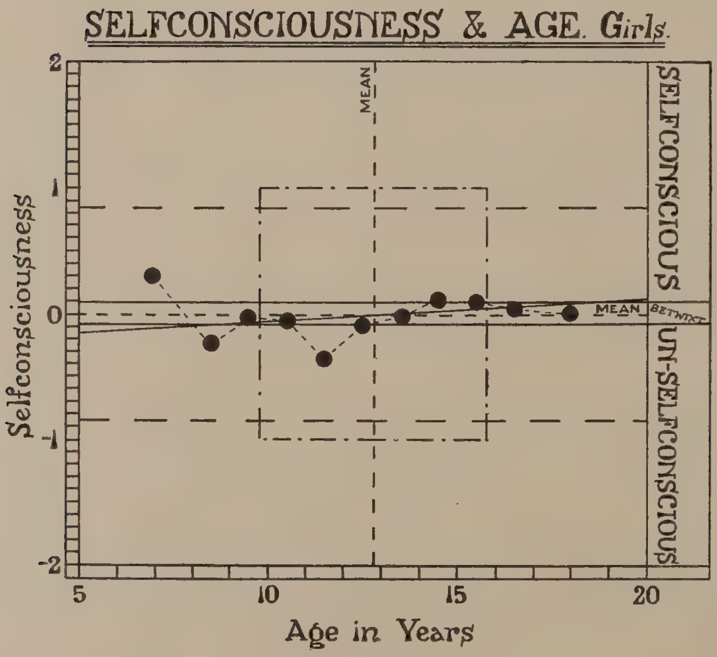

Diagram V^b

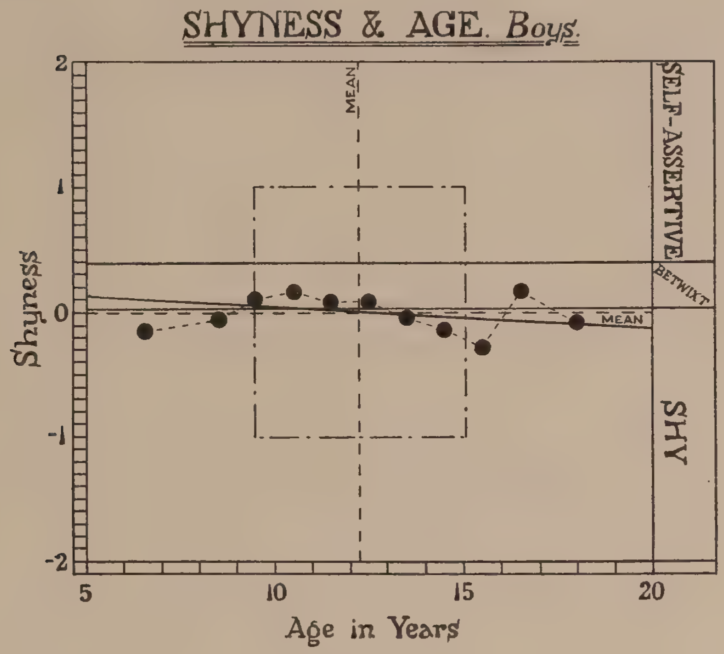

Diagram VI^a

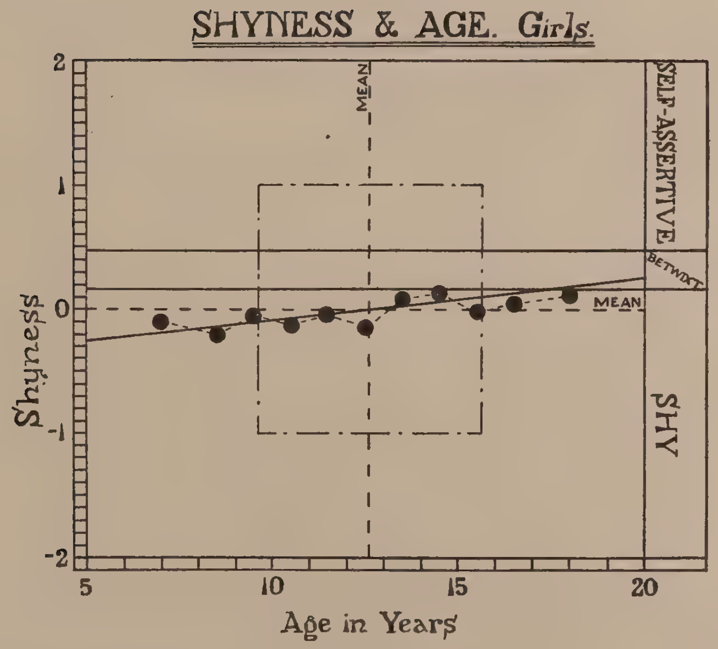

Diagram VI^b

Allowing for such possibilities, however, we see that the correlations are of no real importance. There is—until correlation amounts to ·15 to ·20—no appreciable significance for prognosis and these values are not even of the above order.

(*d*) *Temper and Age.* We now turn to Temper in its three categories, Quick Temper, Good Nature and Sullen Temper.

The correlations between Temper and Age from corrected tri-serial η (Tables XV and XVI of Appendix) are:

$$\text{Boys: } +0{\cdot}015 \pm {\cdot}014, \quad \text{Girls: } -0{\cdot}013 \pm {\cdot}014.$$

It will be seen that neither is significant.

Diagrams VIII^a and VIII^b (p. 15) indicate that growth on the average has no influence whatever on temper. As it is open to the reader to object with some force that Temper is not a continuous variate, I give the 'analograph' for both Quick Temper and Sullen Temper for boys and for girls (Diagram VII). There is clearly no significant alteration in the percentages of each category with age. You cannot change the temper of a child by education, and growth seems to have very slight physiological influence on temper.

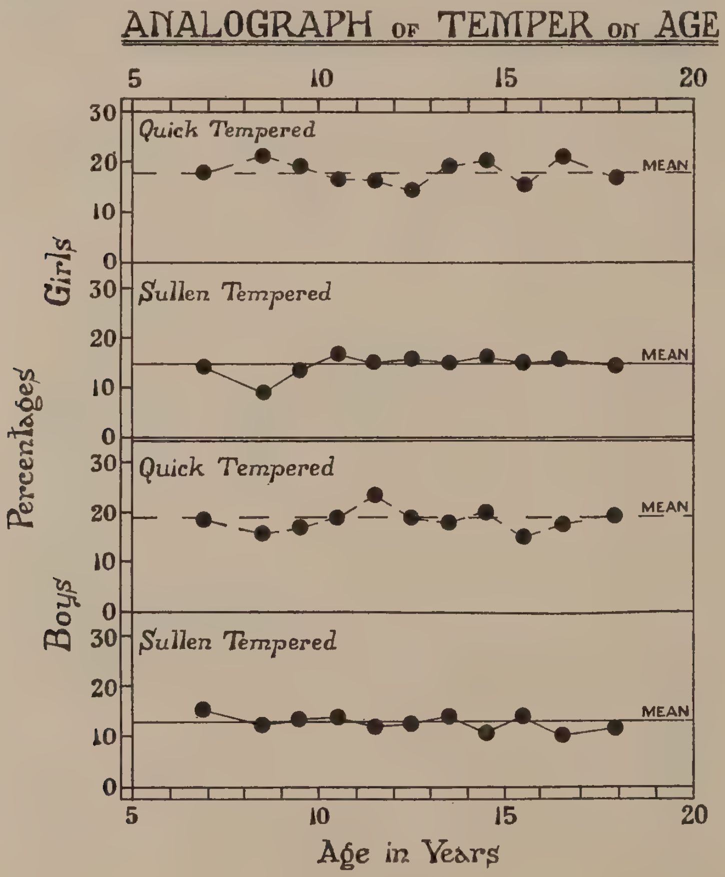

Diagram VII

(*e*) I pass now to *Vivacity and Age* as determined by the Noisy or Quiet character of the child. Here we had a small mid-class of 'betwixts' who formed 8·3 °/。 of the Boys and 6·6 °/。 of the Girls.

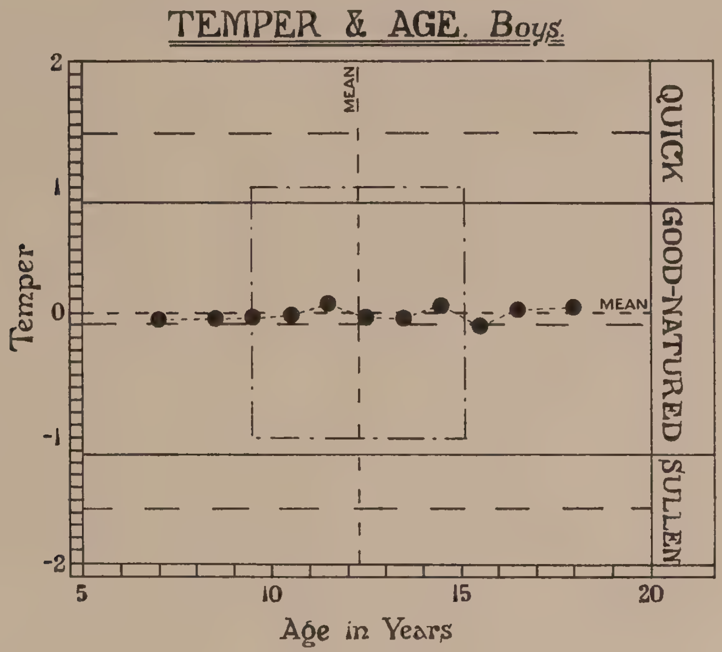

Diagram VIII^{a}

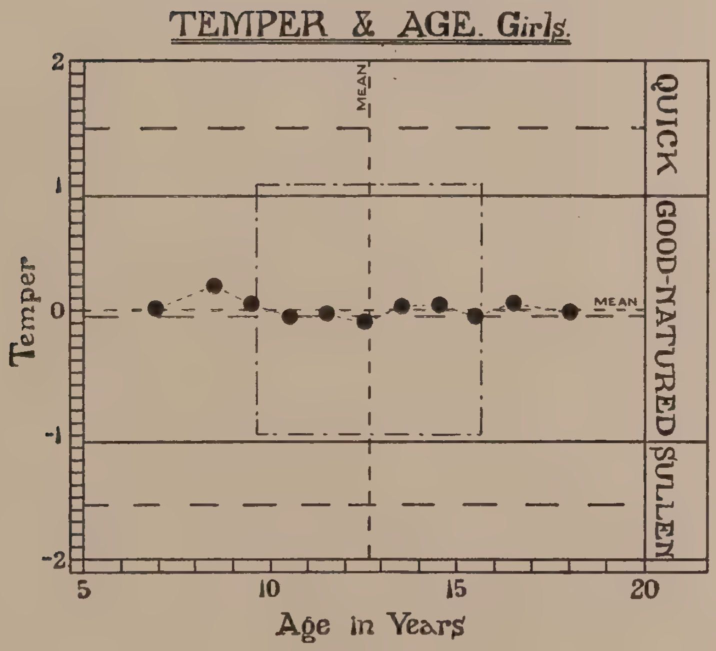

Diagram VIII^{b}

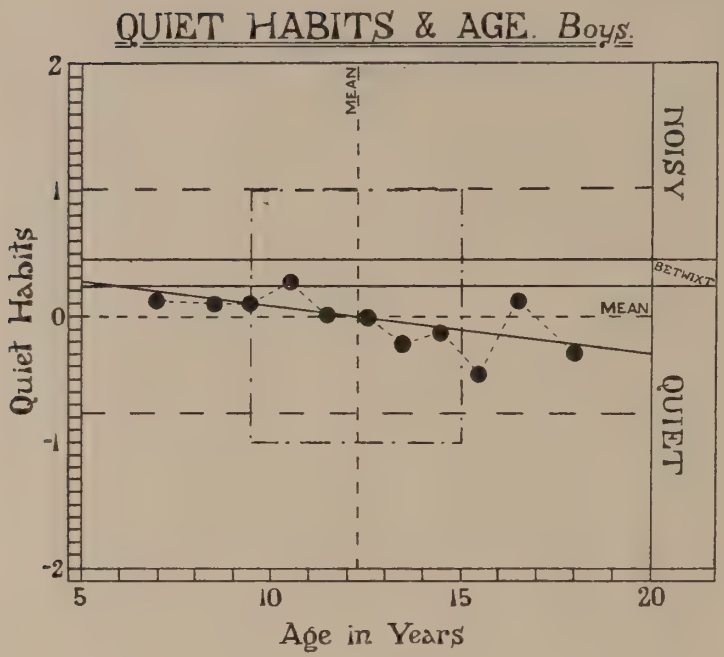

Diagram IX^a

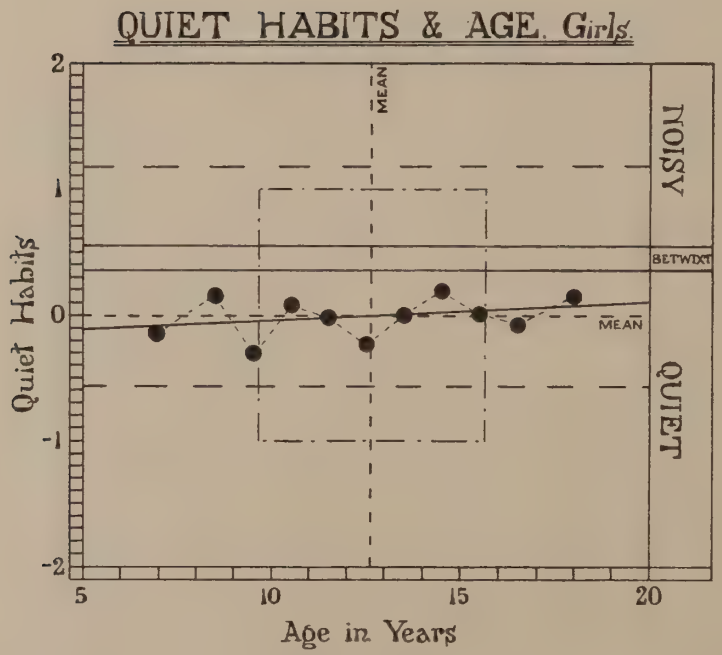

Diagram IX^b

The correlations from corrected tri-serial η (Tables XVII and XVIII of Appendix) are:

$$\text{Boys}: -0{\cdot}132 \pm {\cdot}014, \quad \text{Girls}: +0{\cdot}051 \pm {\cdot}014.$$

Diagrams IX^a and IX^b (p. 16) exhibit the results graphically.

We have here our first substantial change and it is a sexual one. The Girls grow slightly noisier with age, but 15 years will scarcely do more than carry a girl on the border of 'quiet' through the betwixt group to the border of 'noisy'*.

On the other hand the Boys move with growth in the opposite direction; like the girls they start on the average with being quiet, but they do not with growth like the girls become somewhat noisier; they tend to become quieter with age. The range of betwixt is $\cdot 2217 \times \sigma$, and in 15 years the average boy might increase his degree of quietude by $\cdot 6990\sigma$. In other words a fairly noisy infant might wind up his school career by being a fairly quiet lad. Shall we not put this down to the influence of school training? To do so is to make a grave accusation against school-mistresses. If you can change the grade of vivacity of a schoolboy considerably, why do the school-mistresses fail with their schoolgirls? The whole result in my mind is again physiological and due to the sexual difference between girl and boy in their teens. Increased self-consciousness, increased shyness and decreased vivacity are characteristics of the boy in the hobble-de-hoy stage, and are due to his physiological growth, and not the result of school training.

(*f*) *Handwriting and Age.* I now pass to a character which though in part physical is yet largely emotional. I refer to Handwriting. We obtained something like 4000 specimens of classified handwriting. I anticipated finding a marked improvement in handwriting with age, but this is very far from being the case. Allowing for the difference in *character* between the handwriting of an infant and a girl or boy in their teens, there is little or no change in the quality of boys' handwritings and on the average a sensible drop in the quality of girls' handwritings.

The correlations between Age and Handwriting from corrected tri-serial η (Tables V and VI of Appendix) are:

$$\text{Boys}: -0{\cdot}022 \pm {\cdot}015, \quad \text{Girls}: -0{\cdot}128 \pm {\cdot}016.$$

Diagrams X^a and X^b (p. 18) exhibit these results graphically. The reader will see that the change in Boys' Handwriting is trifling, but that the change in Girls' Handwriting, if small, is appreciable. Can the school-master again take the flattering unction to his soul that he is a better teacher than the school-mistress, because Boys do not depreciate in handwriting to the extent of Girls? It would be a poor complacency! For after all the teacher does not succeed in improving the handwriting; he could only say that he very nearly succeeds in maintaining its efficiency. I do not think this is the key to the apparent paradox. This year I have myself been a teacher for forty years; during thirty of those years I gave instruction to young engineers in the drawing office, starting with 50 to 60 freshmen every October, and seeing the work of a hundred or more students

---

* The range of betwixt is $\cdot 1850\sigma$, where σ is the standard deviation of vivacity. The regression line of vivacity on age is $v/\sigma = \cdot 0171 \times \text{age}$, or the range of vivacity in 15 years $= \cdot 2565\sigma$.

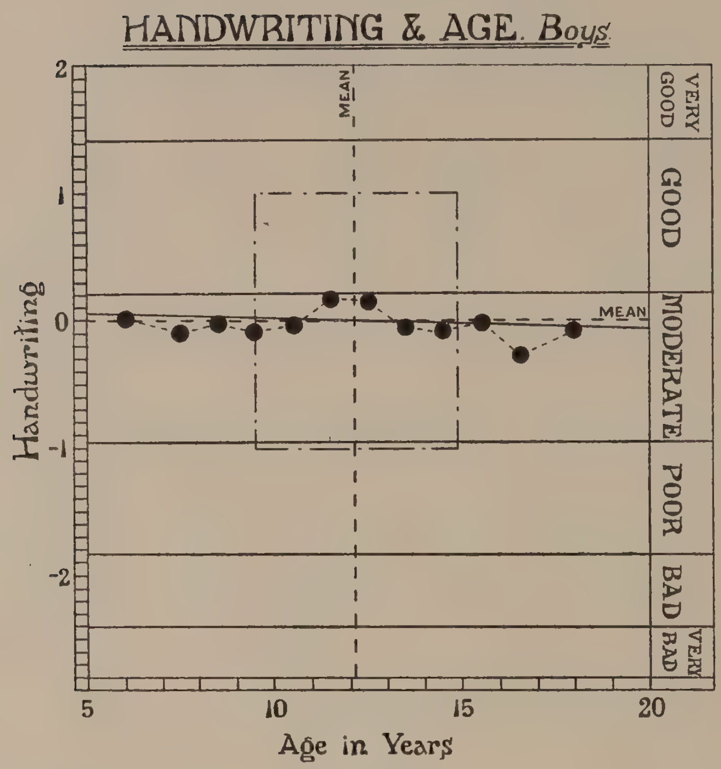

Diagram X^a

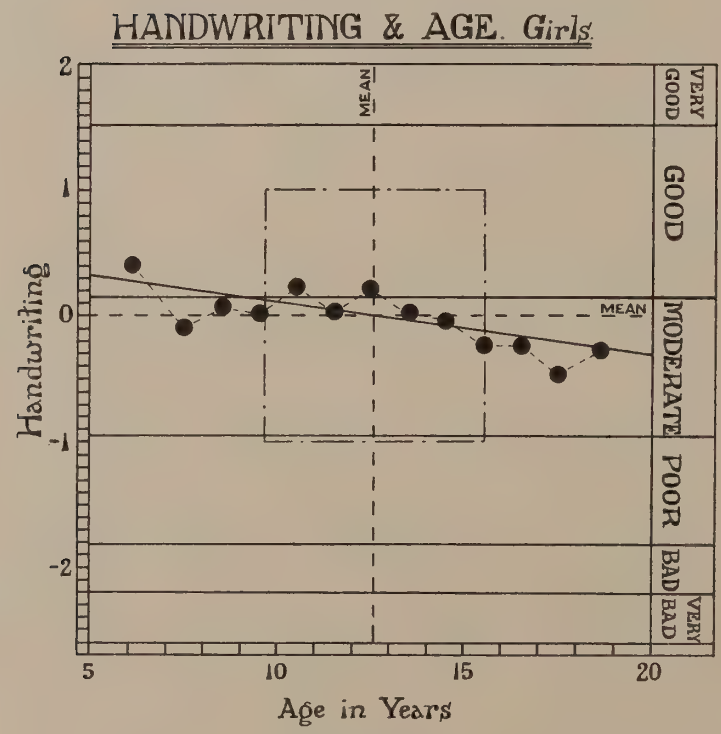

Diagram X^b

yearly. Now drawing is not the same thing as handwriting, but it is closely allied to it. No good draughtsman was ever a bad handwriter, and good drawing requires the same mental and physical coordination that is essential to good handwriting. The hand, the eye and the head have to work in cooperation. That cooperation cannot be really taught; it is innate, like the similar quality in a good mechanical craftsman. I am telling the strict truth when I say, that although a considerable percentage of my engineering freshmen had never learnt drawing at all, I was able after five to ten years' experience to determine, within the first two or three weeks of their instruction, which students would close their career as accomplished draughtsmen. I could teach them what they had to do and how they had to do it, but the mental and physical coordination, on which real success as draughtsmen depends, was innate, and I could not create it where it did not *a priori* exist. I think it is the same with handwriting, and an experienced teacher of handwriting will judge from an infant's pothooks and hangers—if I may use mid-Victorian terms—whether its adult handwriting will be good or bad. But I may be told that I am contradicting myself, for I have previously affirmed that Girls' Handwriting gets worse with age. So it does, and precisely because the coordination of mental and physical efficiency is largely influenced by emotional causes. Of course a great deal of nonsense has been talked by charlatans who profess to read both character and fate in handwriting, but there is a perfectly definite truth in the fact that state of health and state of mind directly affect the character of handwriting. No observant man or woman can fail to appreciate this, if, once awakened to it, they have ever studied the correspondence of an intimate friend. Most of us learn in moments of great stress to control our face, our eyes, our voice, but we too often forget to control our *hands*, and the pocketless woman cannot hide her hands so conveniently as a man. Once with a much older man I heard a woman giving evidence; I said to him: "that woman must be speaking the truth; listen to her voice, and look at her face and eyes." His reply was brief and taught me a great lesson: "Watch her hands." In my youth I was honoured by the friendship of a great Victorian woman, her handwriting week by week was a most sensitive barometer to her physical and emotional condition, and in less emphasised individualities this is also true if in a less marked degree. If we examine now our diagrams we see no change of any sensible character until the boy and girl are between 12 and 13, then the boy's handwriting becomes slightly worse and the girl's distinctly worse. It is I believe the emotional changes of on-coming puberty which are disturbing for a time the coordination of mind and hand. And the disturbance is of a more marked character in Girls than Boys, just as a woman's handwriting, even when she is adult, is more subject to emotional influence than a man's; perhaps, because the male has had to depend for safety on coordination of hand and brain in an age

> "When the grasp on the bow was decision
> And arrow and hand and eye were one,"

or, he perished.

(*g*) Handwriting was one of several characters with which I am in a position to deal which demands properties of both hand, eye and brain. Athletic power is another such character.

(4) Many years ago Rudyard Kipling wishing to stem the tide of athletic enthusiasm, which undoubtedly carried the Englishman away from obvious national duties, wrote the famous lines about

> "The flannelled fool at the wicket
> And the muddied oaf at the goal."

I felt uneasy at the time about those lines, and endeavoured, I hope dispassionately, being no frequenter of cup-football matches, nor ever having rowed in my college boat, to ascertain what if any was the real relation between intelligence and success in athletics. The following table* gives the percentage in each class of intelligence of the athletic and non-athletic.

PERCENTAGE OF
ATHLETIC CHILDREN TO EACH INTELLIGENCE.

Grade

	QUICK INTELLIGENT	INTELLIGENT	SLOW INTELLIGENT	SLOW	SLOW DULL	VERY DULL
Boys						
Athletic	77·62	72·09	65·47	61·41	45·51	44·44
Non-Athletic	22·38	27·91	34·53	38·59	54·49	55 56
Girls						
Athletic	69·21	62·10	54·06	44·57	36·78	37·93
Non-Athletic	30·79	37·90	45·94	55·43	63·22	62·07

Diagram XI

The correlations between intelligence and athletic quality from bi-serial η (Tables XLIII and XLIV of Appendix) are:

$$\text{Boys}: +0{\cdot}214 \pm {\cdot}016, \quad \text{Girls}: +0{\cdot}238 \pm {\cdot}016.$$

These correlations confirm the view to be derived from the above table of percentages, that the relation of athletic power to intelligence, if not very intense, is quite significantly marked, and that it is the intelligent rather than the slow or dull children who exhibit athletic power. Owing to this correlation between intelligence and athletic efficiency I venture to class athletic quality with handwriting, as a semi-psychical character, i.e. one which requires adequate coordination of brain and muscle.

The influence of age on athletic quality is exhibited in Diagrams XII^a and XII^b (p. 21). The correlations from bi-serial η (Tables VII and VIII of Appendix) are:

$$\text{Boys}: -0{\cdot}029 \pm {\cdot}016, \quad \text{Girls}: +0{\cdot}071 \pm {\cdot}017.$$

It is accordingly very slight indeed. I do not lay any stress on the decreasing athletic power in boys and the increasing athletic power in girls. There is practically

---

[*] *Biometrika*, Vol. v. pp. 130—131.

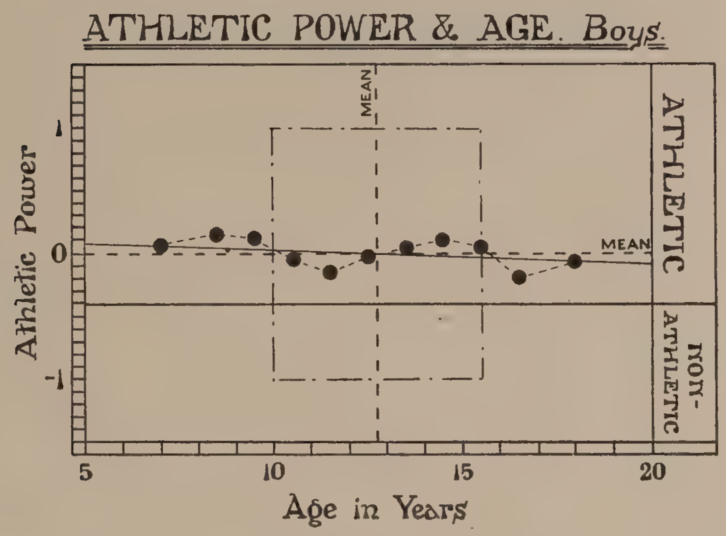

Diagram XII^a

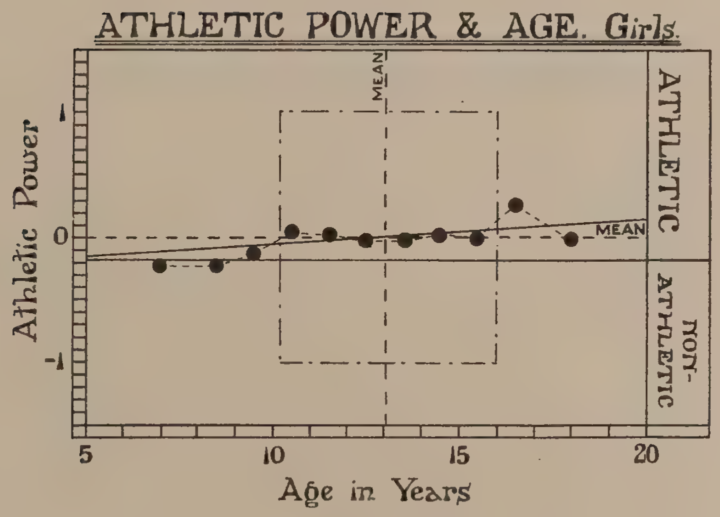

Diagram XII^b

no sensible change with age in boys. The differences arise from the years to 9 and the years after 16. In the early years probably more stress is laid on the games for boys than for girls, and in the last years at school in the big girls' schools there is much emphasis on games, while the older public school boys are often working for scholarships at the university and neglecting games.

There has been so much misrepresentation of the value of athletics in English school life that it may not be without interest to examine how athletics are related to various psychical and physical characters. It seems to me that the charge made against the evil influence of games on English public life is very real and justified, but it has been unfortunately made against the wrong people.

As I have said, Mr Rudyard Kipling has sung to us of the "flannelled fool at the wicket," and "the muddied oaf at the goal"; I believe his condemnation would have been excellent had he only applied it to the onlooker and not to the player—to the spectators who do not play but stand at the line and yell.

We defined our athletic lad to be one who was not only keen on games, *but good at them.* In the schools of England are the boys who show such athletic power fools and oafs?

I draw the reader's attention to the following table which gives the correlations between athletic power and various other physical and mental characters, and we will then consider one or two individual cases.

TABLE δ. *Correlations of Athletic Power with Various Psychical and Physical Characters.*

	Character	Boys	Girls	Tables
Psychical ...	Intelligence	+ ·214 ± ·016	+ ·238 ± ·016	XLIII, XLIV
	Popularity	+ ·351 ± ·029	+ ·291 ± ·030	LXXXVII, LXXXVIII
	Conscientiousness ...	+ ·045 ± ·028	+ ·169 ± ·029	LVII, LVIII
	Self-Consciousness ...	− ·029 ± ·028	− ·005 ± ·028	LIX, LX
	Self-Assertion	+ ·266 ± ·026	+ ·230 ± ·027	LXI, LXII
	Temper (quick) ...	+ ·150 ± ·016	+ ·150 ± ·016	LXIII, LXIV
	Vivacity (noisy) ...	+ ·353 ± ·024	+ ·395 ± ·024	LXV, LXVI
Psycho-Physical	Handwriting	+ ·198 ± ·016	+ ·127 ± ·018	LXVII, LXVIII
Physical ...	Age	− ·029 ± ·016	+ ·071 ± ·017	VII, VIII
	Health	+ ·443 ± ·018	+ ·397 ± ·014	XXXV, XXXVI
	Eye Colour (Pigment)	+ ·070 ± ·016	+ ·036 ± ·016	LXXXV, LXXXVI
	Hair Colour (Pigment)	+ ·077 ± ·016	− ·098 ± ·017	LXXXI, LXXXII
	Set of Hair[*]	·030 ± ·016	·075 ± ·017	LXXXIII, LXXXIV

We have already discussed Intelligence and found a quite sensible correlation between athletic power and intelligence. See Diagrams $\mathrm{XIII}^{\mathrm{a}}$ and $\mathrm{XIII}^{\mathrm{b}}$ on p. 23.

The relation of Conscientiousness to Athletic Power was obtained by a tetrachoric table[†]; the correlations are confirmed by Diagrams $\mathrm{XIV}^{\mathrm{a}}$ and $\mathrm{XIV}^{\mathrm{b}}$ (p. 24), obtained

---

[*] Correlation-ratios.

[†] The 'betwixt' or mid-categories being split.

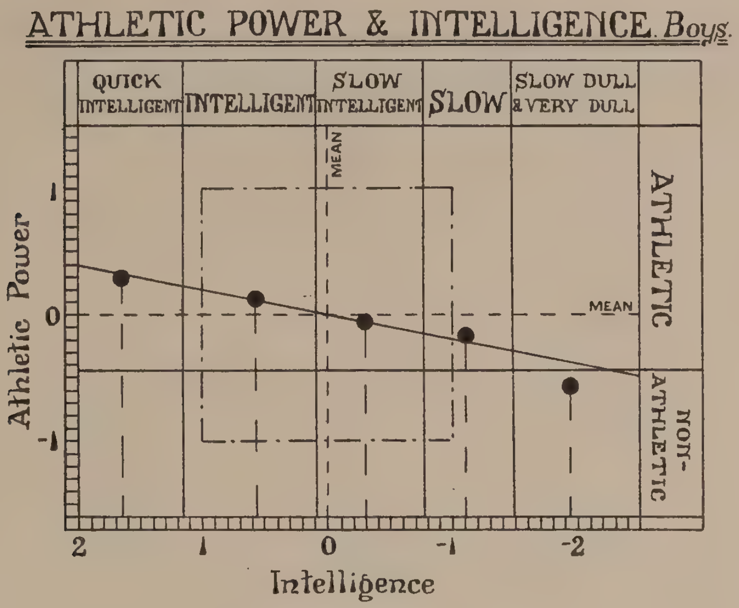

Diagram XIII^{a}

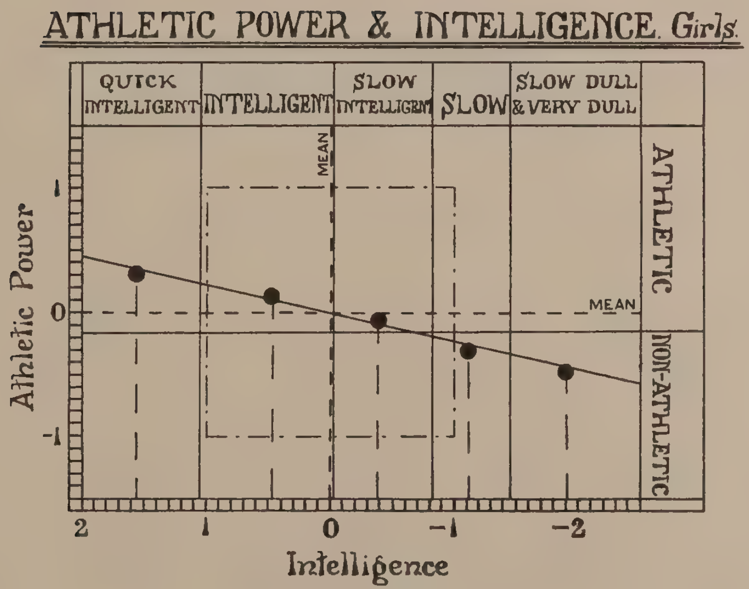

Diagram XIII^{b}

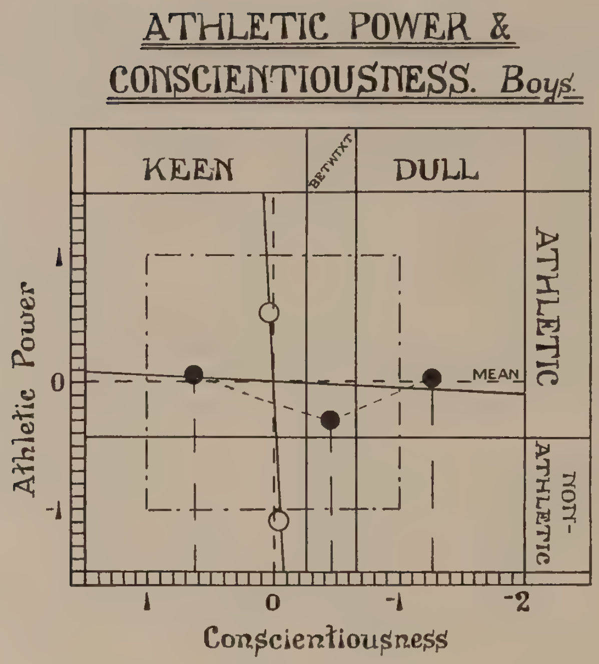

Diagram XIV^a

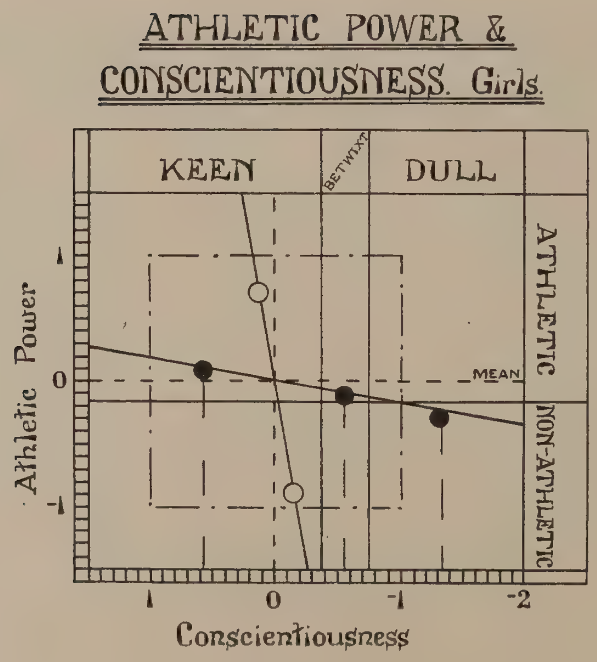

Diagram XIV^b

by a threefold grouping for Conscientiousness and a twofold grouping for Athletics, because the 'betwixt' category is very small.

The relationship if positive is negligible for the boys, it is small but appreciable for the girls, the athletic child being above the average for Conscientiousness.

The correlations of Athletic Power and Self-consciousness are very small, but it would seem that athletic prowess in school-children does not make for Self-consciousness.

Self-assertion was correlated with Athletic Power by a fourfold table, and there is a quite sensible relation between Athletic Power and Self-assertion. This is well brought out in Diagrams XIV^a and XIV^b (p. 26), where we have worked on 2 × 3-fold tables.

Turning to Temper we see a somewhat smaller relation between Athletic Power and this character. Diagrams XVI^a and XVI^b (p. 27) indicate that the athletic are the Quick-tempered, not the Sullen-tempered. The correlations were found by corrected bi-serial η, but the diagrams show that on a normal scale the regression is almost linear.

As we might naturally anticipate there is a fairly large correlation between Vivacity—as measured by 'noisy' and 'quiet'—and Athletic Power. The correlations were obtained from tetrachoric tables and used for the regression lines of the graphs, Diagrams XVII^a and XVII^b (p. 28), obtained from 2 × 3-fold tables.

If we consider Popularity we find the athletic boy is distinctly popular; so also is the athletic girl, but not in quite so marked a degree. The correlations were deduced by a tetrachoric table, and the values of r thus found used to obtain the regression lines on 2 × 3-fold tables as represented in Diagrams XVIII^a and XVIII^b (p. 29).

While the correlation between Athletic Power and Handwriting is not large, it is quite significant. The correlation coefficients were obtained from bi-serial η tables, and Diagrams XIX^a and XIX^b (p. 30) show a remarkably smooth sequence of observations to the regression line especially in the case of the boys.

The correlation of Athletic Power with Good Handwriting is, I think, a valuable result; it indicates that the power of working brain and muscle in unison in one direction is also likely to be evidenced in a second. I have noticed that athletic power goes not only with good handwriting, but with good draughtsmanship. I can recall a whole series of engineering students, only slightly above mediocrity in intelligence, who yet were fine athletes and remarkable draughtsmen.

The relation of age to athletics we have already discussed (see p. 20 and Diagrams XII^a and XII^b (p. 21)). By finding bi-serial η (Athletic Power on Age) we can raise the associations to ·105 for Boys and ·111 for Girls, but a glance at Diagrams XII^a and XII^b (p. 21) does not indicate that any simple form of skew regression is likely to describe the observations better than our linear regression, using bi-serial values of r.

Health as we might naturally anticipate is relatively highly correlated with Athletic Power (see Diagrams XXXIX^a and XXXIX^b (p. 57)). To this point we return later.

Of the anthropometric characters we chose three: amount of pigment in the eye (light eyes against medium and dark), amount of pigment in the hair (red and fair as against brown, dark and jet black) and the set of the hair (smooth, curly and wavy). None of them showed any association of importance, and for eye colour and hair set it does not seem needful to provide diagrams. I have provided diagrams, however,

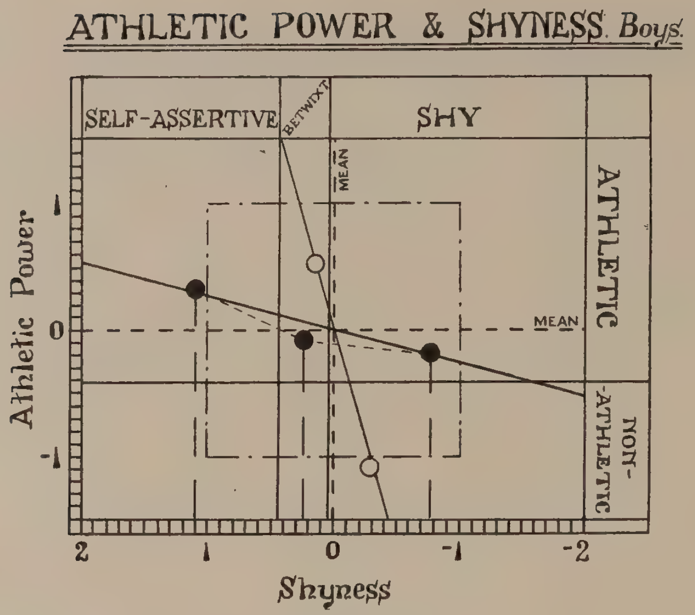

Diagram XV^a

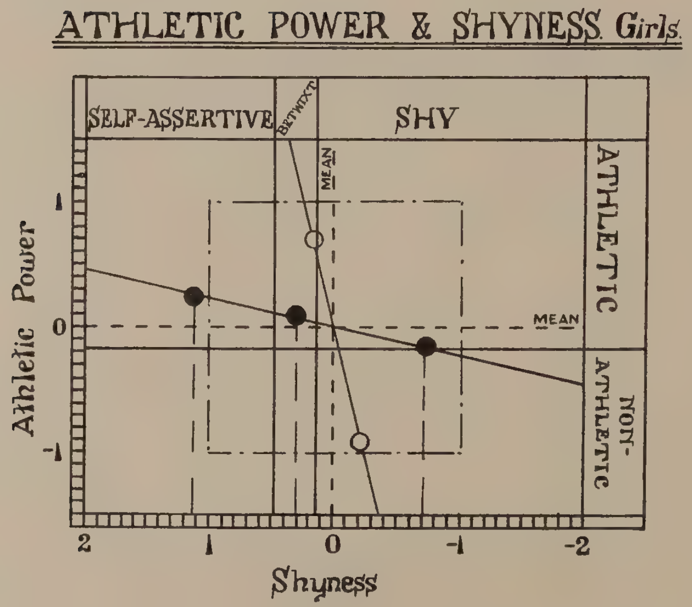

Diagram XV^b

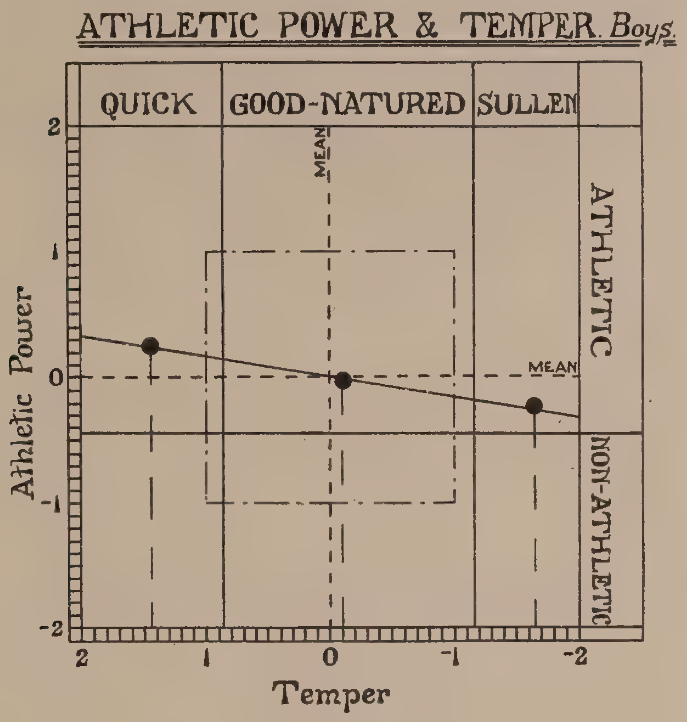

Diagram XVI^a

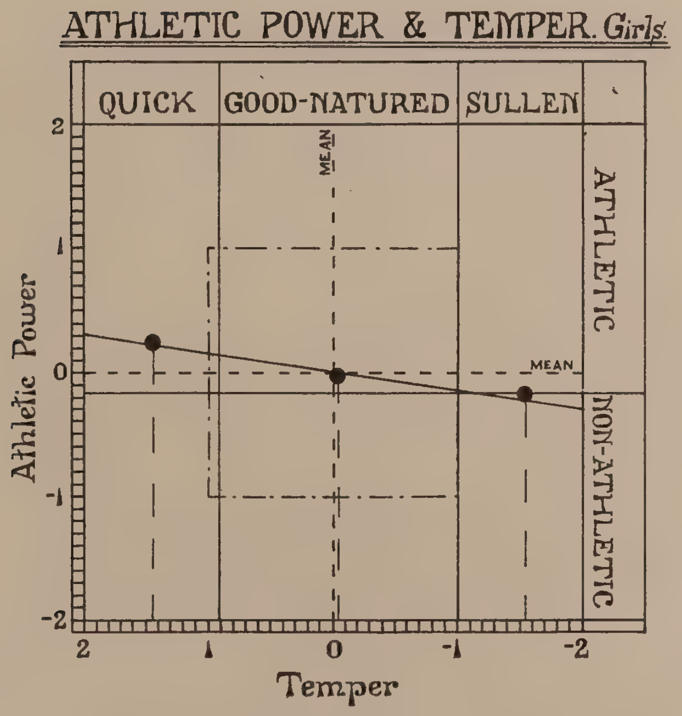

Diagram XVI^b

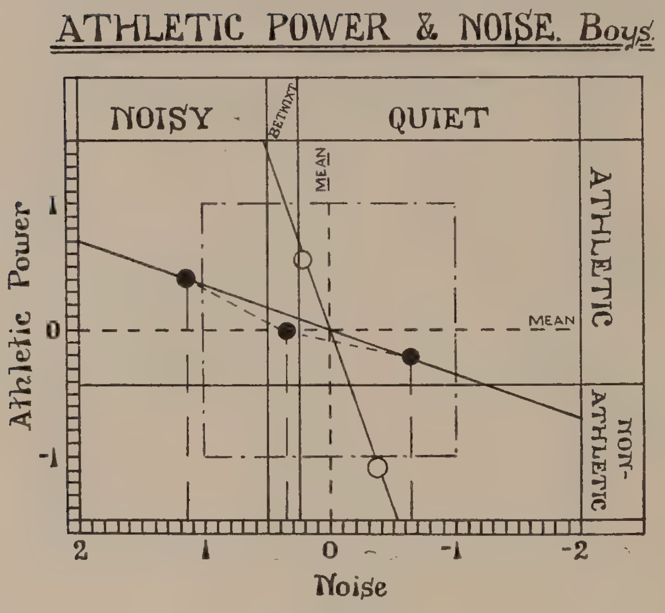

Diagram XVII^a

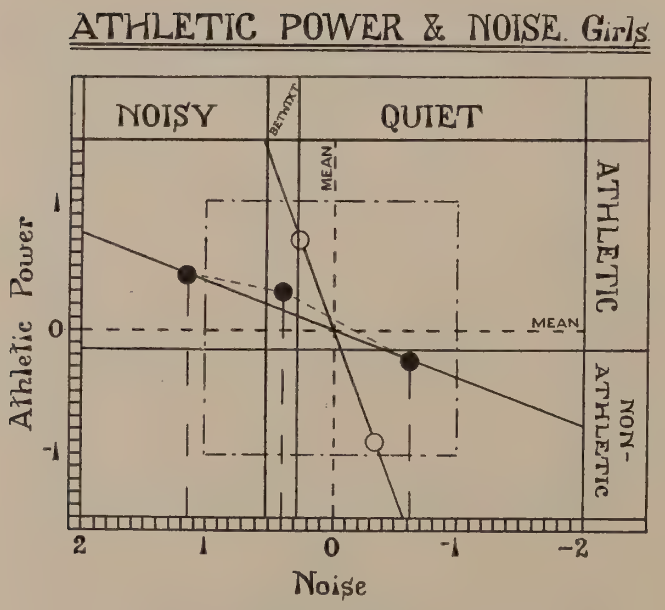

Diagram XVII^b

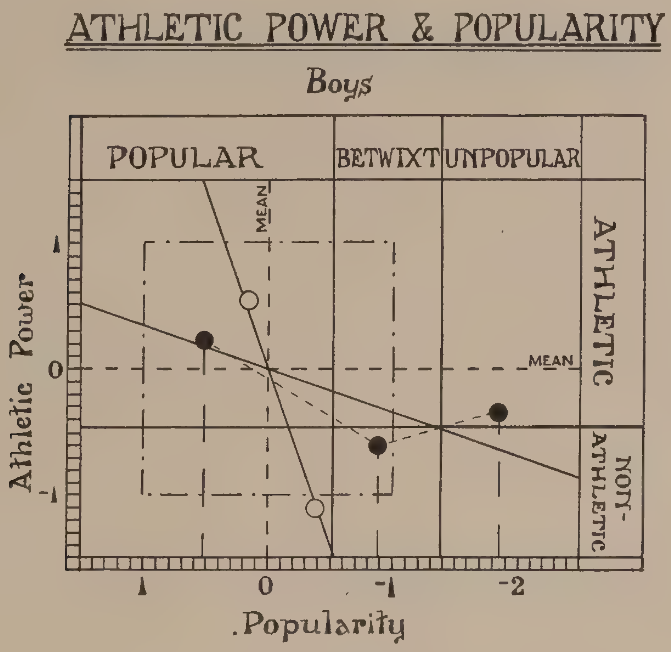

Diagram XVIII^{a}

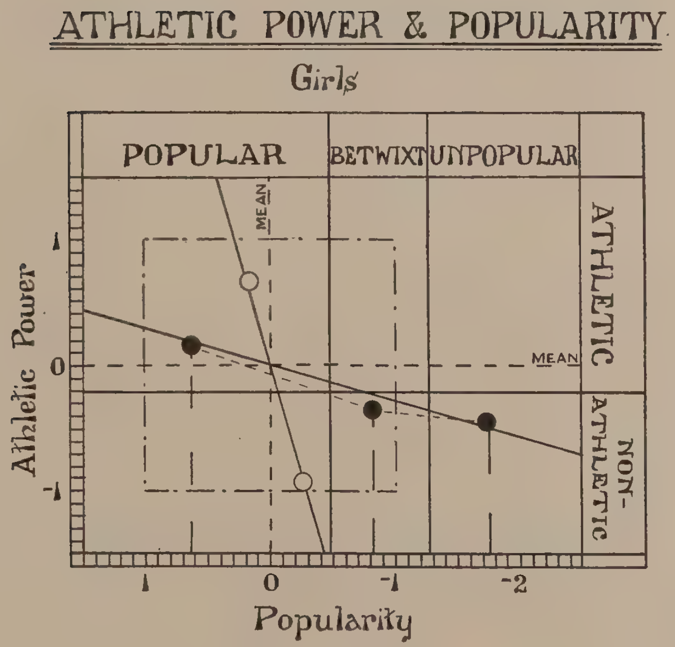

Diagram XVIII^{b}

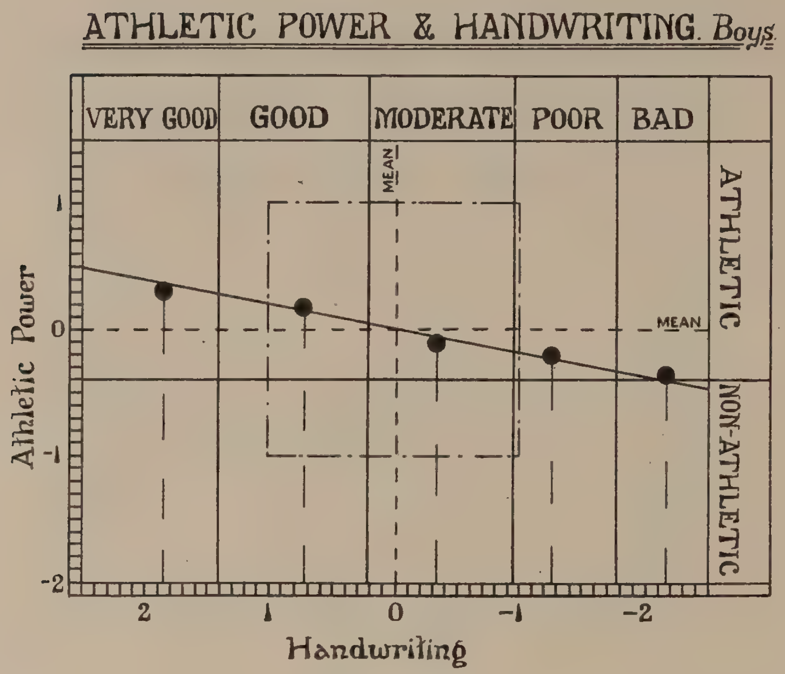

Diagram XIX^a

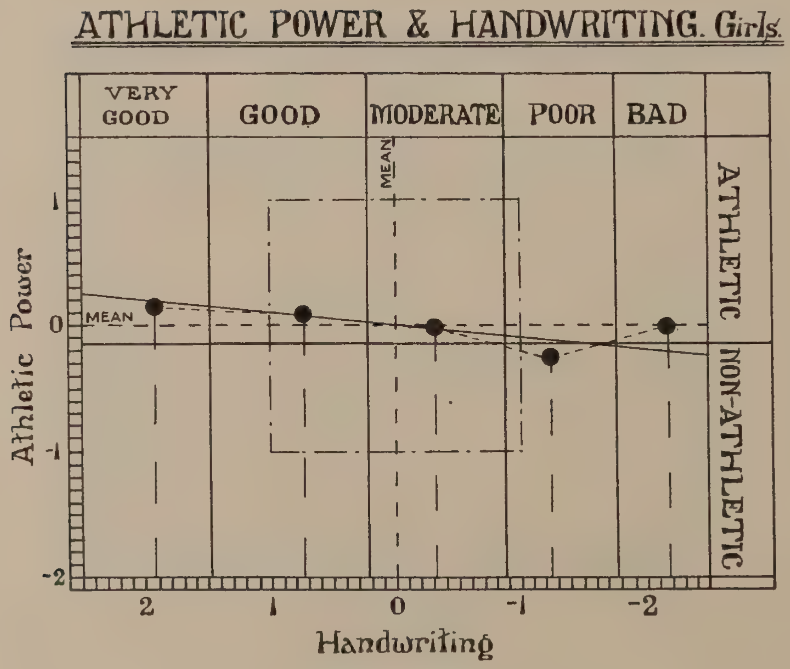

Diagram XIX^b

for hair colour (Diagrams XX^a and XX^b (p. 32)), because in the case of Boys and more markedly in the case of Girls there appears, while no sign of differentiation exists in athletic power between fair, brown or dark-haired children, to be some sign of increased athletic power in the red-haired. There is little association between athletic power and racial pigmentation, although the red-haired are slightly more and the blue-eyed very slightly less athletic.

There is no statistical reason for describing this healthy, reasonably intelligent and fairly conscientious, if somewhat self-assertive and undoubtedly noisy child, who is quick-tempered, but not sullen, as having the makings of fool or oaf. He is in several respects better, in none worse, than the average child. The stress should be laid on the folly of those nations and sections of nations who spend their leisure not in training muscle and mind to cooperate, but in looking on while others perform; those who have a greater inclination to become professional backers than half-backs, and who like Romans or Spaniards pay gladiators and matadors to run their games for them. The battle of Waterloo was won, said the Duke of Wellington, on the playing fields of Eton, and thereby expressed a partial, but a great truth. An equally partial, but a still greater truth lies in the assertion that our country may be defeated in the great struggles of the future by the spirit of the mob which frequents cup-finals, or the stadium when a fight is on, to thrill its nerves and not to exercise brain and muscle in unison.

(5) (*h*) Lastly we will consider what effect growth or education continued during school life has on the somewhat obscure category of School Popularity.

That certain children are popular, and that certain others are unpopular, among their comrades, are well-recognised features of school society. The fact is familiar to every teacher, who really observes the life about him. He is able at once to say that A is a popular boy, and B is not. But he might be far less able to determine what are the exact characteristics on which this popularity depends. What characters in a boy or girl tend to make them popular in school life? Are they popular because of their mental or their physical characters? Is it because they are healthy and athletic? Or, because they are intelligent or conscientious, or good-natured or self-assertive, or noisy? To what extent does even personal appearance, eye colour, hair colour, or curl of hair affect school judgment? These are questions we can to some extent answer from our data. We will, however, first consider what effect the years of school life have on the characteristics whatever they may be which make a child popular.

Diagrams XXI^a and XXI^b (p. 33) indicate our results. There is not much change in popularity among Boys until they are 14 years old, then there is a fall, which if not very extensive is continuous. In Girls the change is not so late, it seems to begin between 11 and 12, and up to those years popularity increases, but beyond those years is a much sharper fall than in the case of Boys. It is clear that the older children beyond the age of puberty are less popular among their comrades.

The correlations of age and popularity deduced by bi-serial η (Tables XIX and XX of Appendix) are:

$$\text{Boys}: -0{\cdot}075 \pm {\cdot}015, \quad \text{Girls}: -0{\cdot}196 \pm {\cdot}015.$$

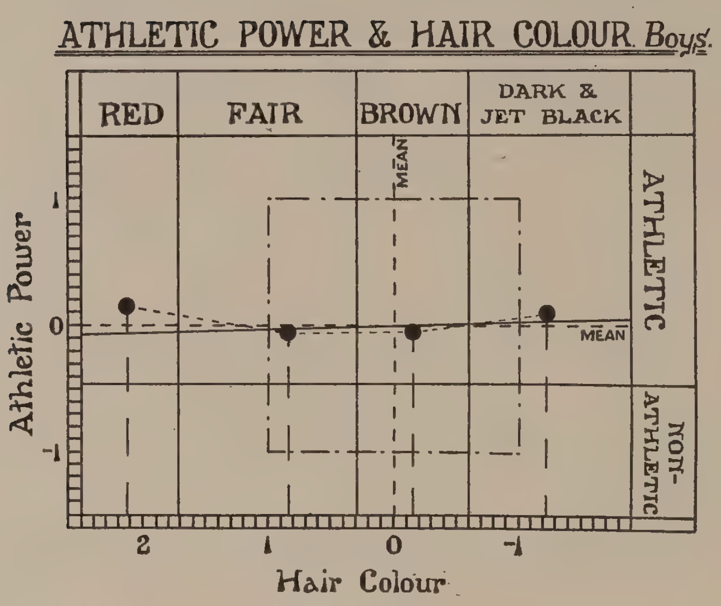

Diagram XX^a

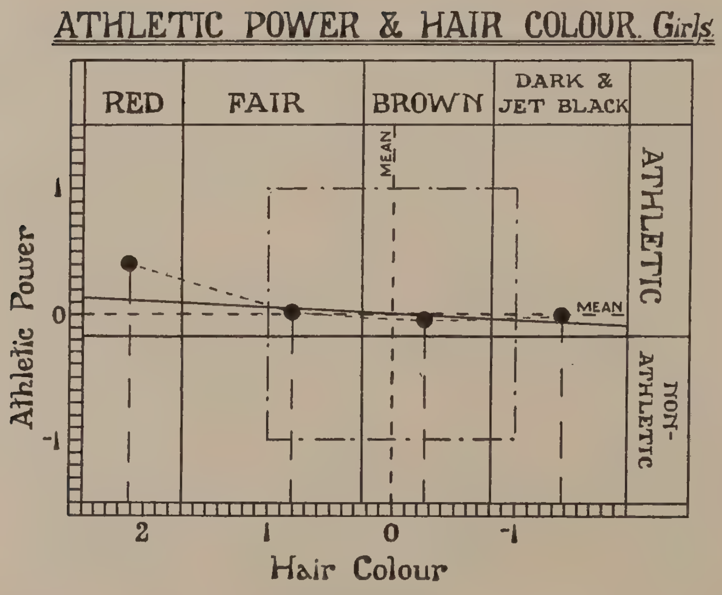

Diagram XX^b

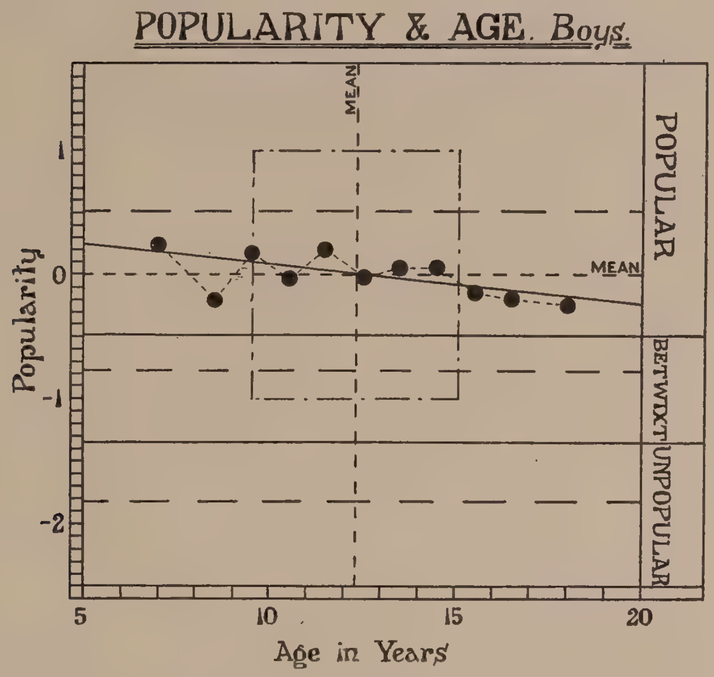

Diagram XXI^a

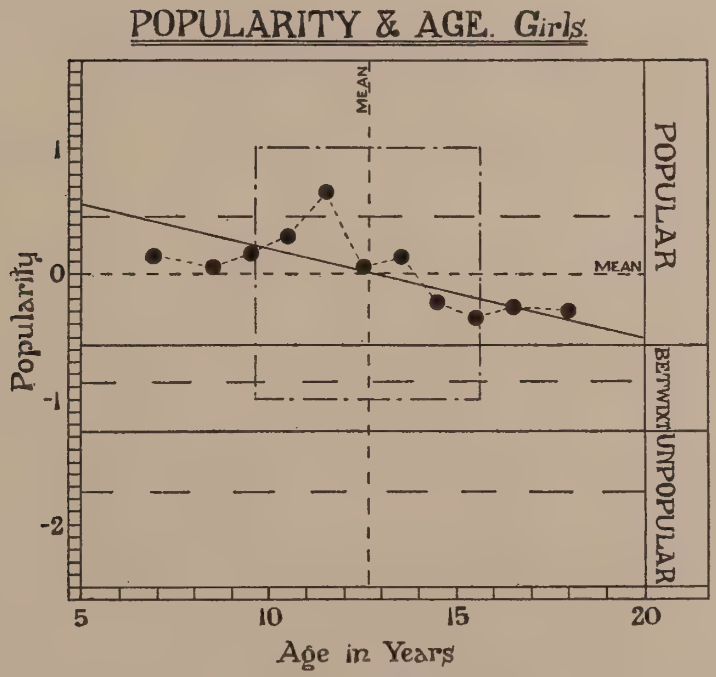

Diagram XXI^b

The regression is quite inadequate in the case of boys to carry on the average a popular boy between the ages of 4 and 19 across the 'betwixt' zone to unpopularity; he might lose his popularity, but would not become unpopular. In the case of girls the 'betwixt' zone is of range ·6903σ, and the average depreciation in popularity in 15 years is ·6867σ, so that there is a much nearer chance of a girl with some, if small, grade of popularity being transferred as she grows older to the verge of unpopularity. It may be reasonably questioned, however, whether a straight line suffices to describe adequately the changes of the characteristic popularity with age in girls.

(6) I now turn to the analysis of the factors which are chiefly associated with Popularity in school life. I give first a table of the correlations which have been determined. These were found by tetrachoric tables for Popularity with Conscientiousness, Self-Consciousness, Self-Assertion, Vivacity, Athletic Power and Eye Colour; by tri-serial η with Temper, Handwriting, Health, Set and Pigmentation of Hair, and by bi-serial η with Intelligence. The diagrams were based on 3 × 3 and 3 × 2-fold tables.

TABLE ϵ. *Correlations of Popularity with Various Psychical and Physical Characters.*

	Character	Boys	Girls	Tables
Psychical ...	Intelligence	+ ·234 ± ·014	+ ·322 ± ·014	XLV, XLVI
	Conscientiousness ...	+ ·421 ± ·027	+ ·383 ± ·028	LXIX, LXX
	Self-Consciousness ...	− ·056 ± ·029	− ·215 ± ·028	LXXI, LXXII
	Self-Assertion	− ·044 ± ·029	− ·073 ± ·029	LXXIII, LXXIV
	Temper*	·327 ± ·014	·345 ± ·014	LXXV, LXXVI
	Vivacity	− ·025 ± ·028	− ·014 ± ·029	LXXVII, LXXVIII
Psycho-Physical	Handwriting	+ ·207 ± ·016	+ ·285 ± ·016	LXXIX, LXXX
	Athletic Power ...	+ ·351 ± ·029	+ ·291 ± ·030	LXXXVII, LXXXVIII
Physical ...	Health	+ ·199 ± ·015	+ ·144 ± ·015	XXVII, XXVIII
	Eye Colour (Pigment)	− ·074 ± ·028	− ·046 ± ·029	XCIII, XCIV
	Hair Colour (Pigment)	− ·221 ± ·015	− ·057 ± ·015	LXXXIX, XC
	Hair Set*	·004 ± ·016	·219 ± ·015	XCI, XCII

We will now consider the more influential of these factors of Popularity at a little greater length.

Popularity and Intelligence show an almost linear regression in Diagrams XXII^{a} and XXII^{b} (p. 35) from the Quick Intelligent to the Very Dull children. If the correlations be not as great as we might hope for, still they are quite appreciable even in a nation which lays generally no great stress on mental powers.

Popularity and Conscientiousness show a 50 $^{\circ}/_{\circ}$ higher correlation than Popularity and Intelligence, which is at least satisfactory from the moral standpoint. The correlations are relatively substantial and the regressions as exhibited in Diagrams XXIII^{a} and XXIII^{b} (p. 36) reasonably linear.

The Self-conscious Boy is very slightly less popular, but Self-conscious Girls are much more markedly less popular; Unself-consciousness attracting girls even more than Health. See Diagrams XXIV^{a} and XXIV^{b} (p. 37).

---

* Correlation-ratios.

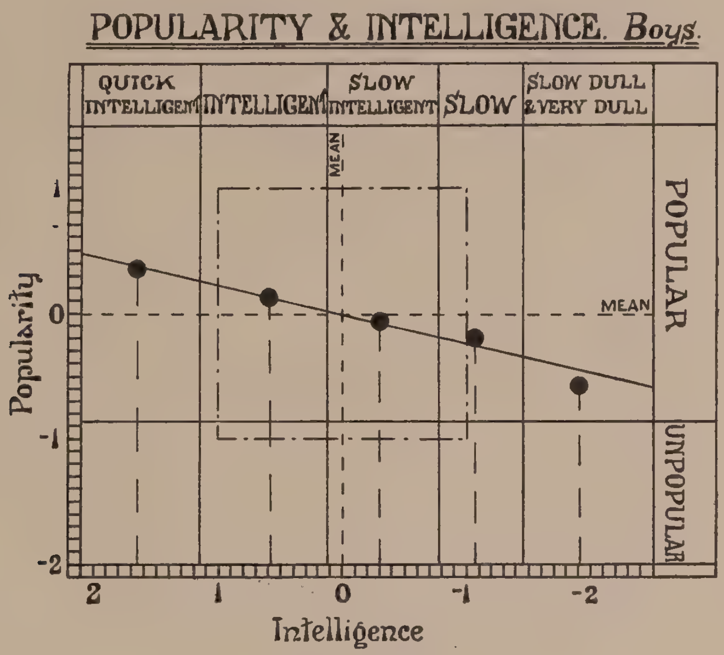

Diagram XXII^a

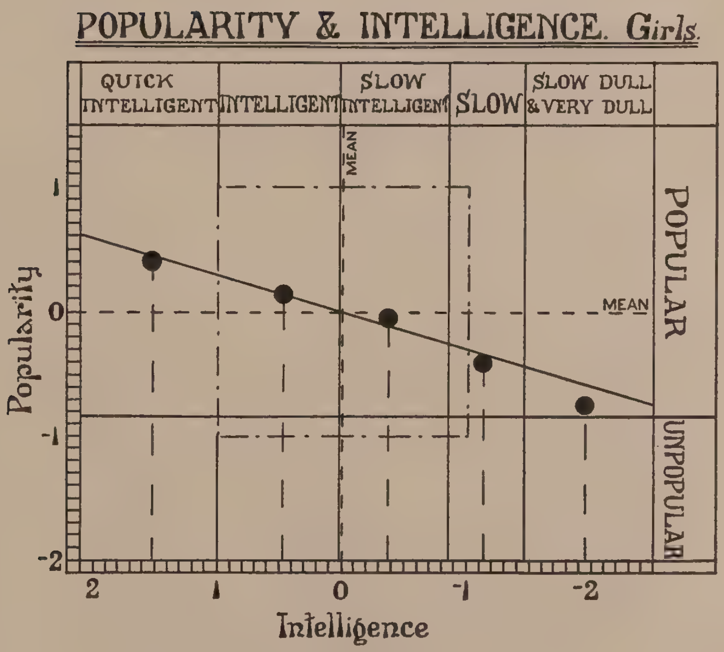

Diagram XXII^b

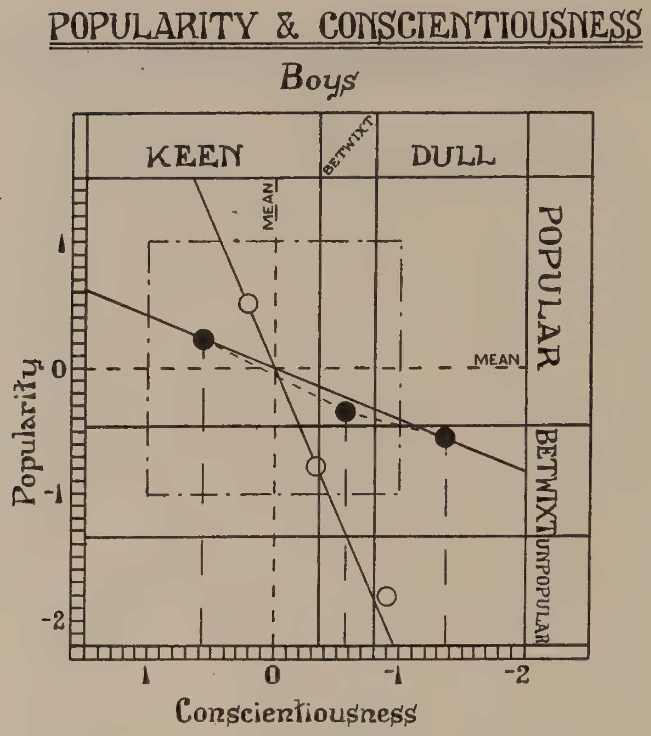

Diagram XXIII^a

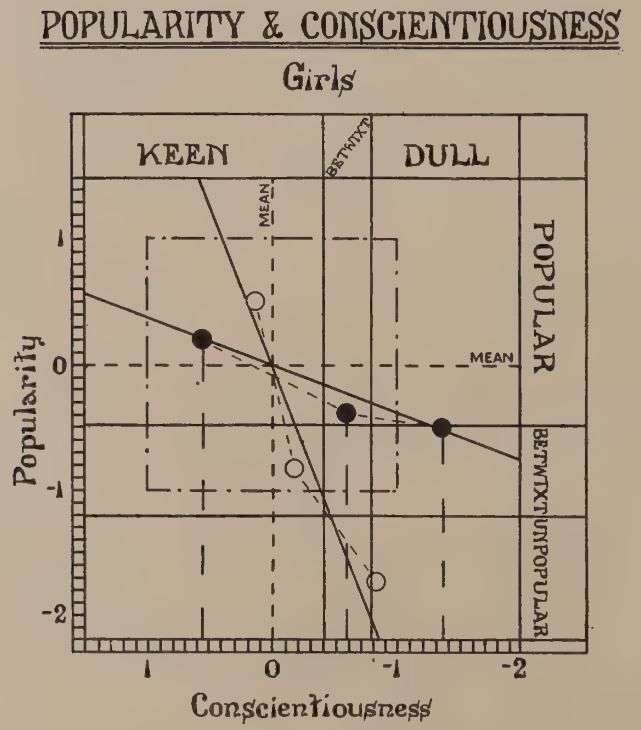

Diagram XXIII^b

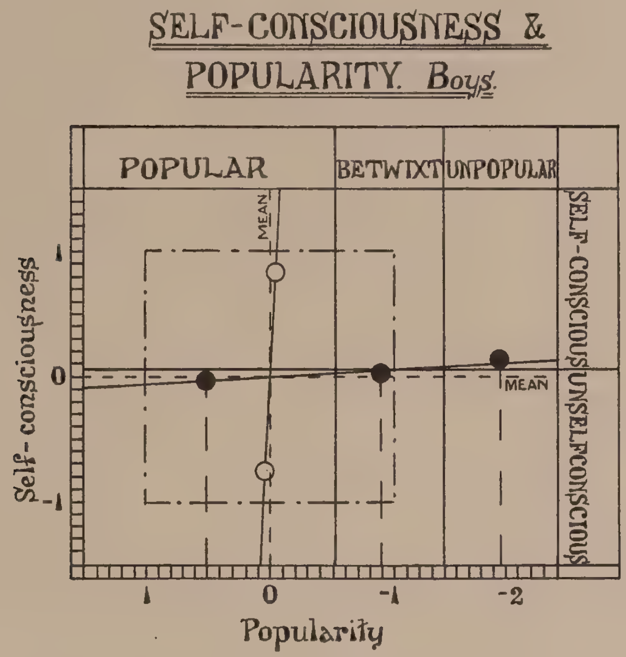

Diagram XXIV^a

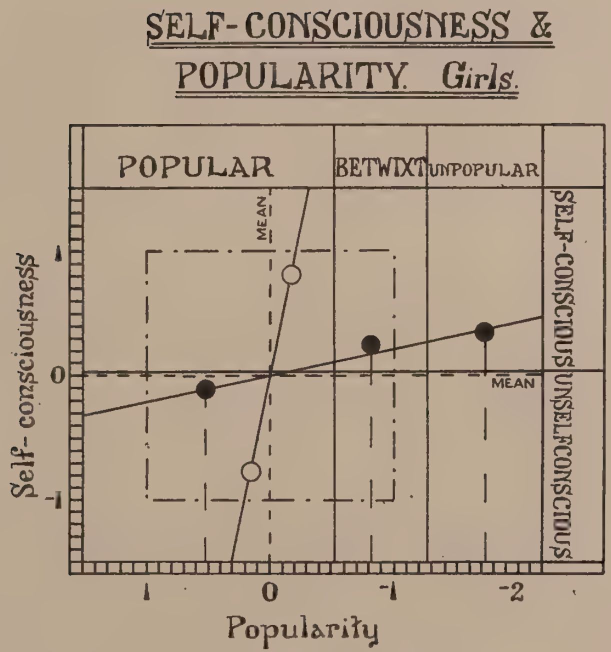

Diagram XXIV^b

It is satisfactory to find that Self-assertion is not an important factor in popularity; self-assertive children being slightly *less* popular than shy children, but the correlation is of no importance.

Temper has more influence than Intelligence on Popularity, approaching the influence of Athletic Power. The regression line is markedly curved; the Good-natured are the most popular, but the Quick-tempered are only slightly behind and much ahead of the Sullen-tempered. See Diagrams XXV^a and XXV^b (p. 39).

Our last psychical character is Vivacity, and we note with satisfaction that although the correlation for both boys and girls is practically non-significant, yet the school-child's judgment is not in favour of the noisy individual. See Table of Correlations, p. 34. The school in this matter sets a good example to the political world, wherein noisiness appears to be a very influential factor of popularity.

We now turn to the psycho-physical characters, and we find a considerable association between Good Handwriting and Popularity. This cannot be accounted for by the relations* we have already pointed out between Popularity and Athletics, and between Handwriting and Athletics. It is probably due to the fact that an intimate correspondence between brain and muscle not only affects the Athletic Power and the quality of Handwriting, but it appears in many other forms likely to win the respect of a school population. The relation between Popularity and Handwriting—almost linear—is exhibited in Diagrams $XXVI^a$ and $XXVI^b$ (p. 40).

That Popularity should be associated with Athletic Power is not surprising. But the influence of athletic achievements on Popularity is on the whole not as great as we might well have anticipated considering the stress laid in this country on sports. It comes below Conscientiousness as a factor, and in Girls, but only in Girls, it is less important than Intelligence. The factor of Temper is also more important with Girls, and runs Athletic Power fairly close in the case of Boys. Diagrams $XVIII^a$ and $XVIII^b$ give graphically the relation between Athletics and Popularity: see p. 29.

Lastly we may consider the purely physical characters. I have selected Health and three statical characters, Eye Colour, Hair Colour, and Set of Hair, as likely to mark racial difference.

There is a significant, but not very large, correlation between Health and Popularity, the Boys laying more stress on Health than the Girls. See Diagrams $XXVII^a$ and $XXVII^b$ (p. 41). It is clear that the correlation is not very well expressed by a linear relation. Health has clearly little influence on Popularity with the Robust and Normally Healthy, but is more markedly influential with the Very Robust and with Delicate children. The graphical results would be closely described by cubic curves.

The hair and eye correlations are of small importance, see p. 34; blue-eyed children are very slightly more popular than dark-eyed children, but the correlations are so small as not to be of the slightest prognostic value. When we turn to hair colour we notice a remarkable result: Fair, Brown, or Dark to Jet Black hair has no influence on either Girls or Boys; but Red-haired boys are remarkably popular, and Red-haired girls have

---

* The partial correlations of handwriting on popularity for constant athletic power are far from vanishing.

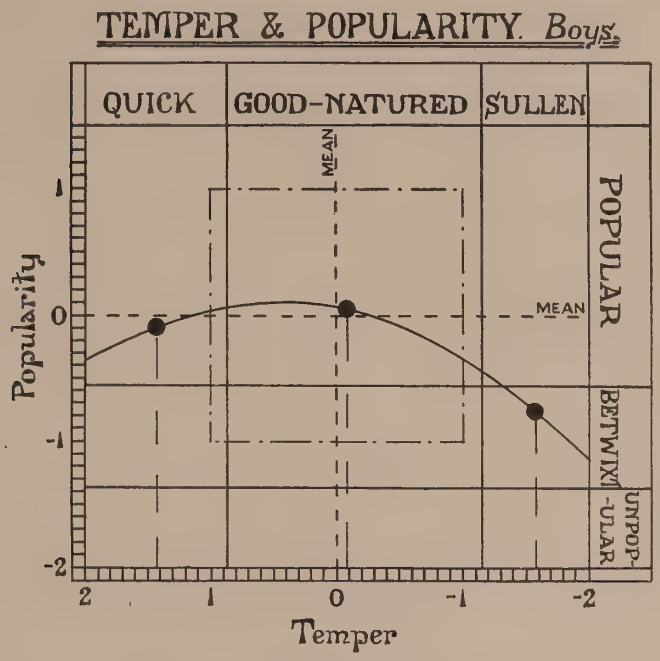

Diagram XXV^{a}

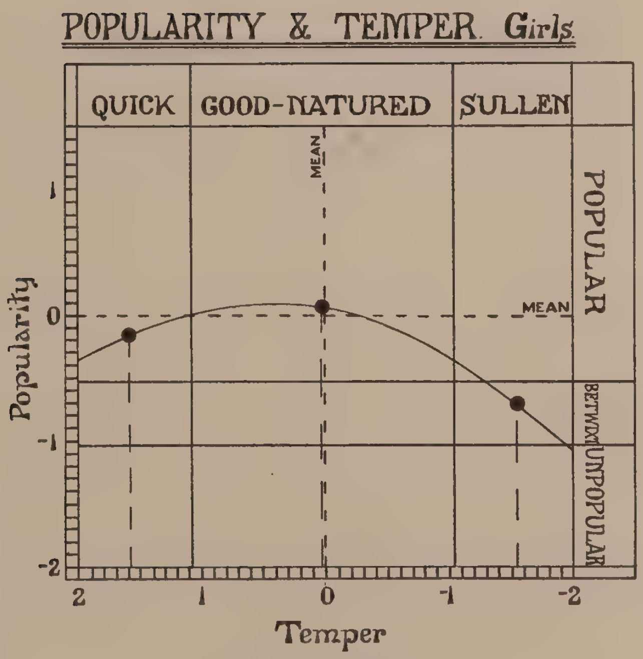

Diagram XXV^{b}

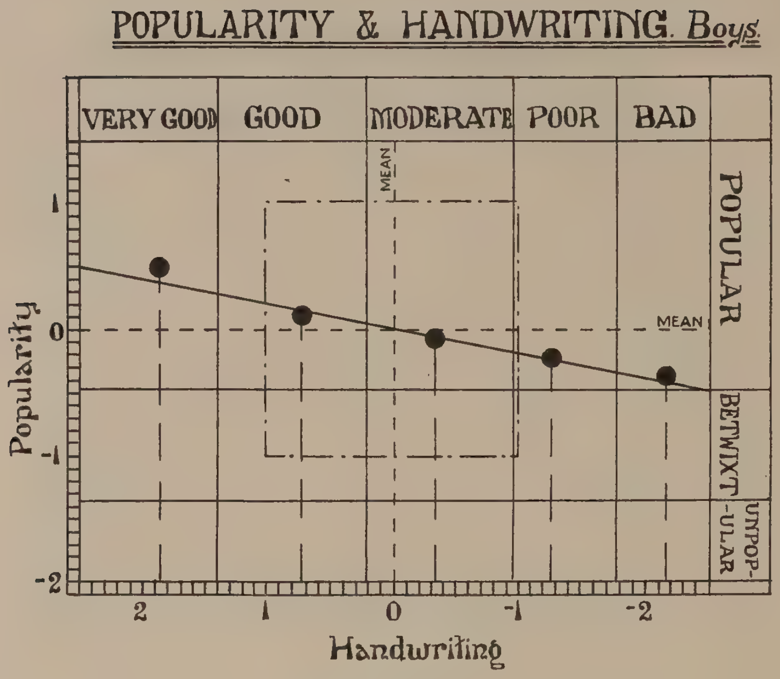

Diagram XXVI[a]

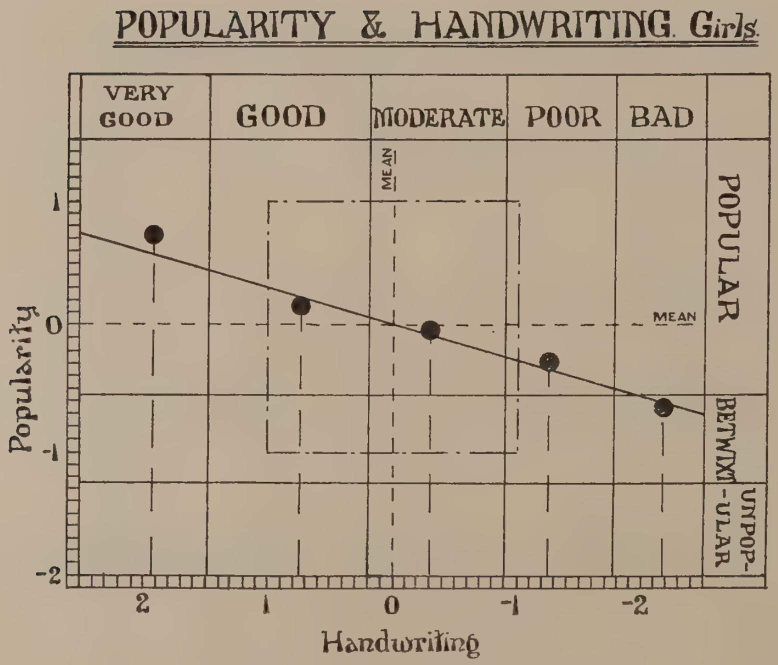

Diagram XXVI[b]

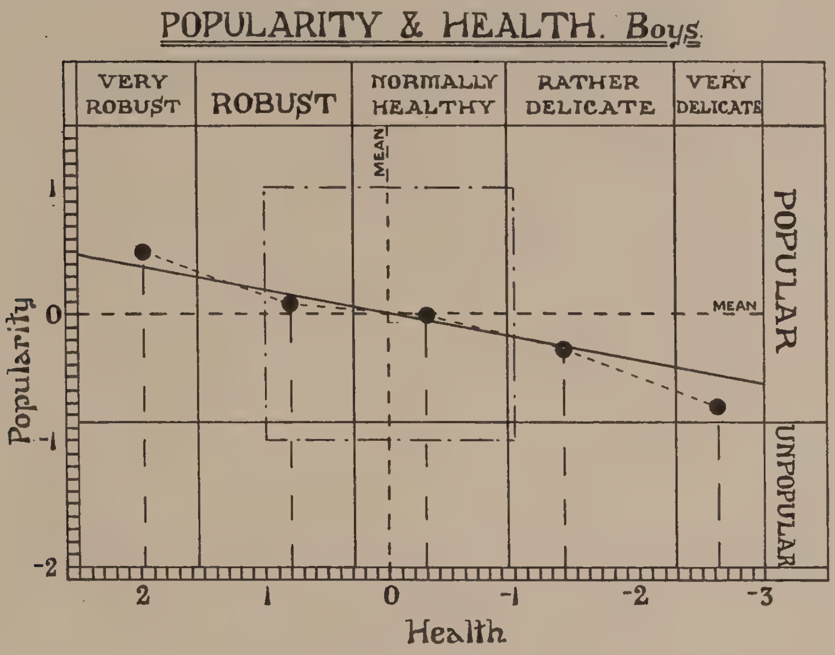

Diagram XXVII^a

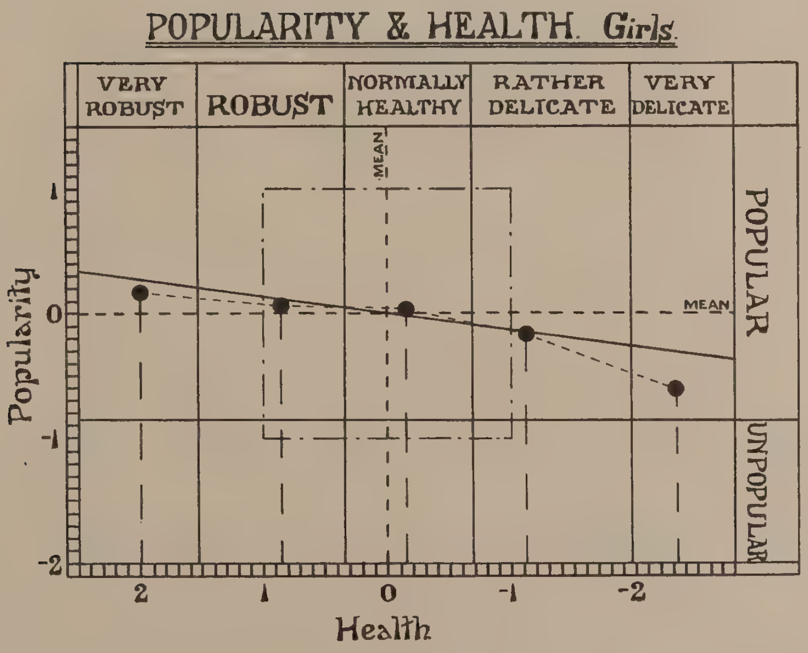

Diagram XXVII^b

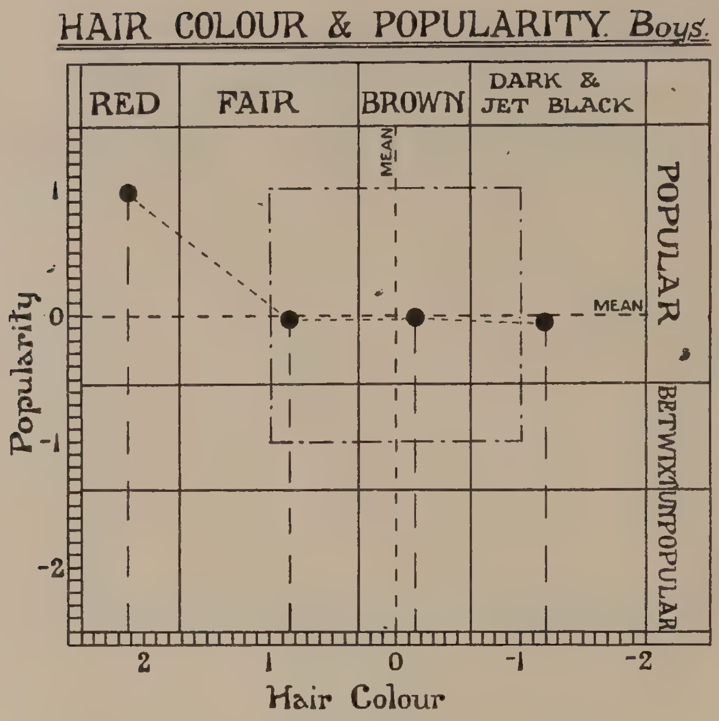

Diagram XXVIII^a

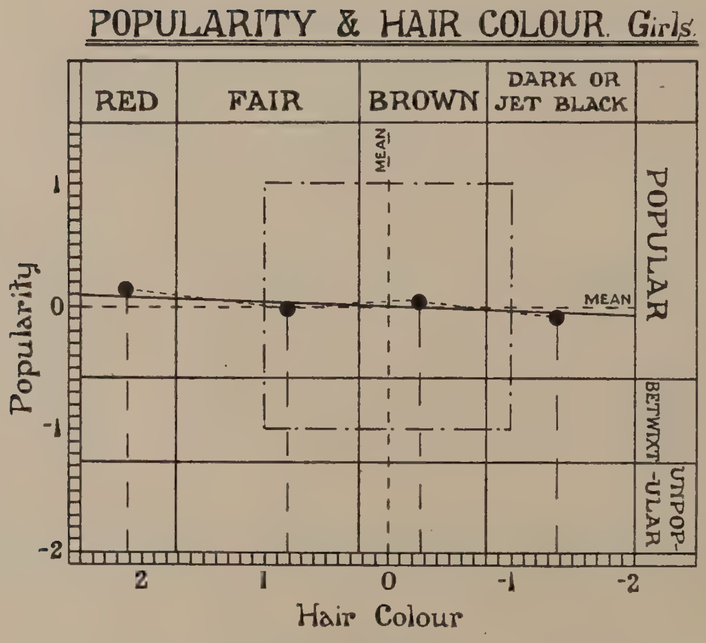

Diagram XXVIII^b

the same tendency although in a much less degree[*]: see Diagrams XXVIII^{a} and XXVIII^{b} (p. 42). Boys pay no attention to the set of their hero's hair, but this cannot be said of Girls, who apparently lay stress on the school heroine having *wavy* hair. See Diagrams XXIX and XXIX^{b} (p. 45). It is possible, however, that the shortness of Boys' hair prevents waviness having its full contributory influence on male popularity. To sum up: the popular child is not self-conscious, self-assertive, sullen-tempered or noisy; it is conscientious, good-natured, and athletic. It will have its full share of intelligence, a reasonable modicum of health and possess a decent handwriting. A red-haired boy and a wavy-haired girl have some advantages, but as a whole racial characters do not weigh much. It seems to me that taken all round school popularity is not a judgment to be disregarded. The school-child distinctly approves the better members of its community, although, perhaps, it might give a better relative weighting to the factors of its judgment, i.e. we should like to see the greatest stress laid on intelligence and health. Undoubtedly the reader will say that he has long known the popular schoolboy to be the all-round good fellow. Well, all I have tried to do here is to measure the relative numerical importance of the factors which make a boy an 'all-round good fellow.'

(7) Returning now from this digression on the factors concerned in Popularity, we may sum up our results for the influence of growth and education on the psychical and psycho-physical characters in the following table:

TABLE ζ. *Correlations indicating the Influence of Growth and Length of Education.*

On	Boys	Girls
General Intelligence ...	− 0·054 ± ·014	− 0·081 ± ·014
Conscientiousness ...	+ 0·052 ± ·015	+ 0·076 ± ·015
Self-Consciousness ...	+ 0·054 ± ·015	+ 0·028 ± ·015
Self-Assertion	− 0·024 ± ·015	+ 0·074 ± ·015
Temper	+ 0·015 ± ·014	− 0·012 ± ·014
Vivacity	− 0·132 ± ·014	+ 0·051 ± ·014
Popularity	− 0·075 ± ·015	− 0·196 ± ·015
Handwriting	− 0·021 ± ·015	− 0·128 ± ·016
Athletic Power[†] ...	− 0·029 ± ·016	+ 0·071 ± ·017
Health[‡]	+ 0·031 ± ·014	− 0·035 ± ·014

Admitting therefore that there are significant, but slight changes in Vivacity in boys and in the Popularity and Handwriting of girls—arising probably from physiological changes, and most likely only of a temporary character—we are forced to the conclusion that not only our psychical characters, but our psycho-physical characters and our general health do not *on the average* change with age; they are not susceptible of any substantial modification by fifteen years of education. This to me is a very important and very certain fact. Ought teachers to be disheartened by it? I say: Most assuredly not. Teachers do not create the child, any more than the carpenter manufactures the steel of his chisel. It is the parents who create the child and are responsible for its being of sound metal. All—and a very important all—that the carpenter can do is to temper his chisel, and see that within the limits of the goodness of its material, it will function adequately. He adds knowledge to native intelligence, he supplements native character by a suitable training, and if he achieves this he is a true educationalist.

---

[*] The red-haired child does not in the least accord with mediaeval folklore as to the wickedness of red-haired individuals. On the contrary I find him popular, athletic, intelligent and conscientious. But I must postpone a fuller discussion of that topic until my paper connecting temperament and anthropometric characters is published. It is possible that a certain number of our red-haired children were Scots in English schools.

[†] Corresponding values of correlation ratios are, Boys: ·105 ± ·016, Girls: ·111 ± ·016.

[‡] The corresponding correlation ratios are, Boys: 0·046, Girls: 0·054.

If he starts with the idea that he can on the average change the mental characters of a child; if he believes that he can substantially modify its innate intelligence, as many modern educational theorists—usually without the length of experience that sees their pupils' adult careers—assume they can do; then I think the educationalist is blind to demonstrable scientific facts. He is shifting true responsibility from the shoulders of the parents on to his own already overburdened back. It is they, not he, who created the child, and on them, not on him, must the blame be laid, if the steel be bad, and the child be unworthy of its nation.

(8) Having freed ourselves from the necessity of correcting our results for growth we can now turn to the main object of our inquiry and ascertain to what extent health is a factor of importance in regard to the psychical and psycho-physical characters of children.

(*a*) We take first the relation of Health to General Intelligence. We will illustrate this in various ways. We have first the Diagrams XXX^a and XXX^b (p. 46) showing the fairly steady fall in intelligence with health. Still more apparent are the relationships if we use percentages for each grade of intelligence. I represent the result by what I term an 'analograph'*.

The following are the percentages of Quick Intelligent and Intelligent and of Slow Dull and Dull on which Diagram XXXI (p. 47) is based.

TABLE η. *Percentages of Intelligence of each Category of Health.*

	Very Robust	Robust	Normally Healthy	Rather Delicate	Very Delicate	Whole Population
Boys						
Quick Intelligent and Intelligent ...	53·8	45·8	46·5	36·5	42·3	45·8
Slow Dull and Very Dull	6·5	6·0	7·5	12·0	19·2	7·8
Girls						
Quick Intelligent and Intelligent ...	53·0	56·8	51·6	39·4	40·9	51·8
Slow Dull and Very Dull	6·0	5·1	5·8	10·3	12·2	6·8

---

* *Biometrika*, Vol. v. p. 129.

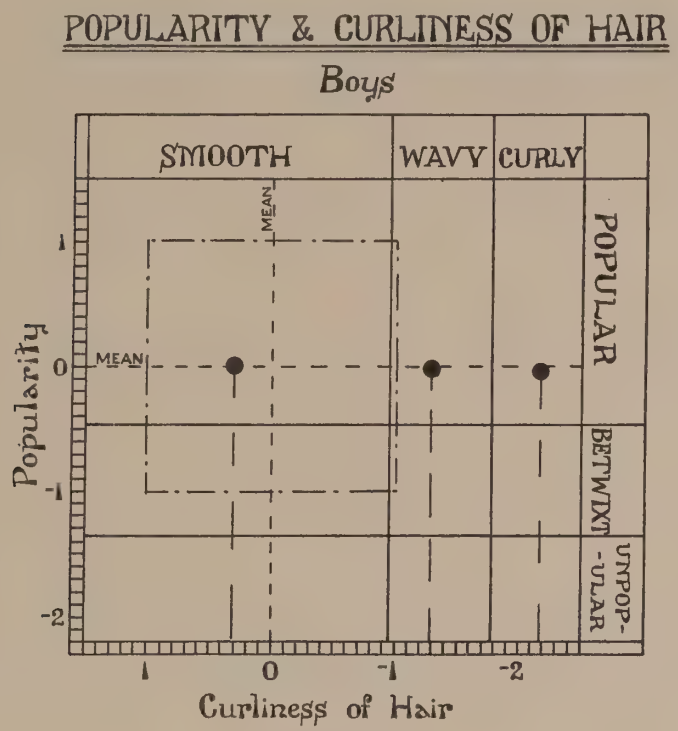
POPULARITY & CURLINESS OF HAIR
Boys

Diagram XXIX^{a}

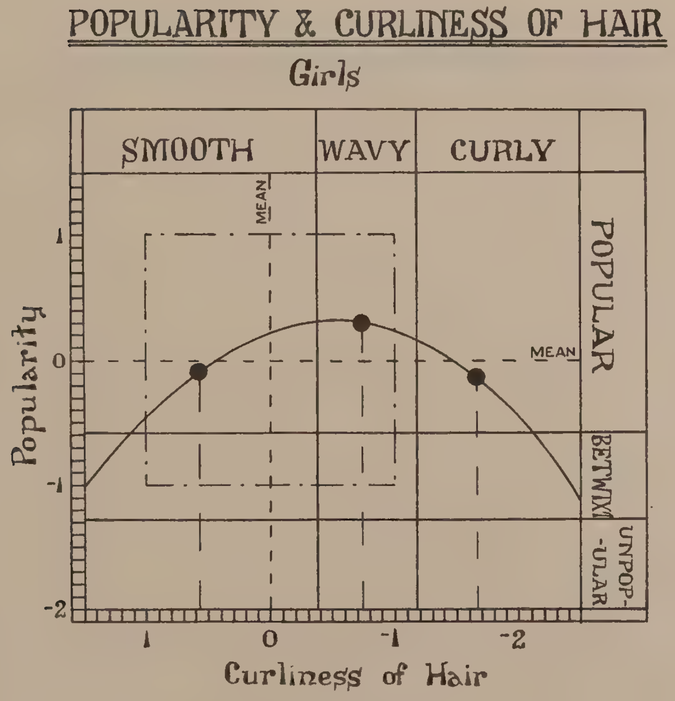
POPULARITY & CURLINESS OF HAIR
Girls

Diagram XXIX^{b}

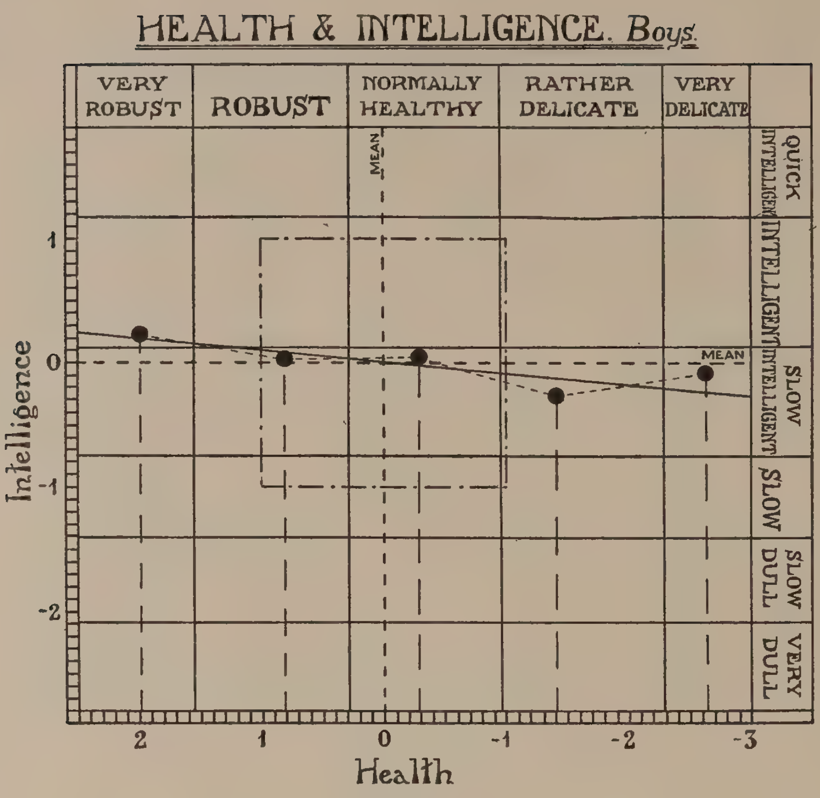

Diagram XXX^a

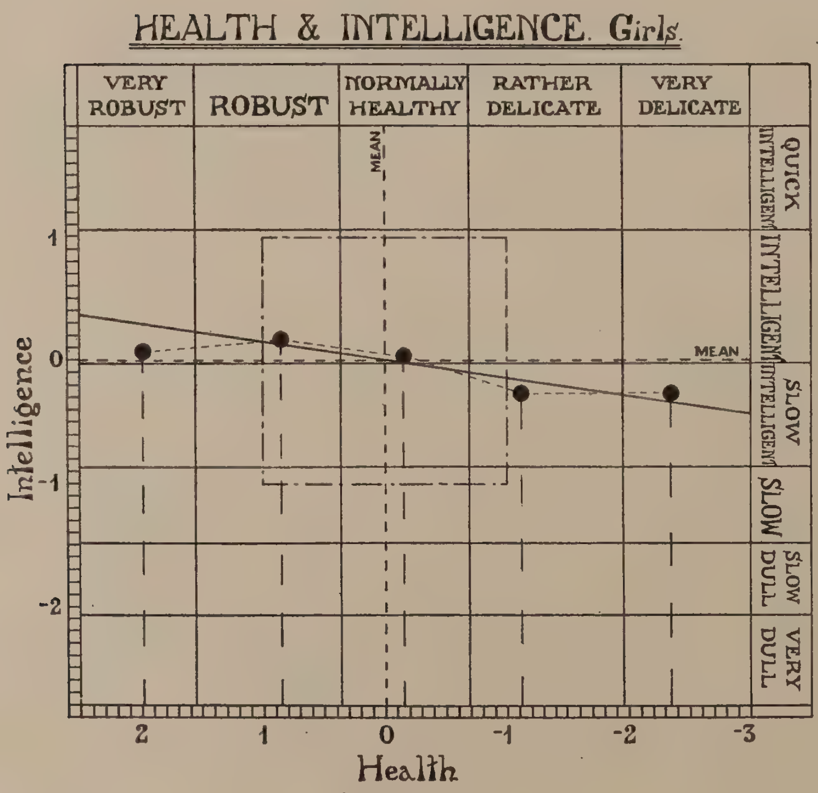

Diagram XXX^b

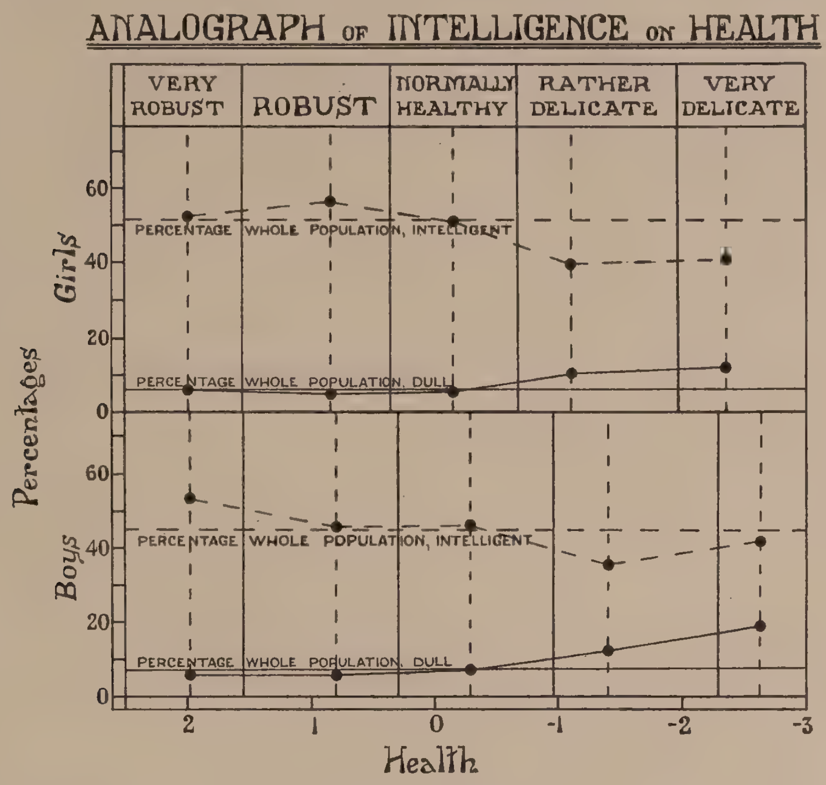

Diagram XXXI

All these graphs do indicate that Intelligence is associated with Health, but it is hard to judge from such graphs or from percentages the real intensity of the correlation. For that we require the correlation coefficients* (see Tables XLVII and XLVIII of Appendix). We have:

Boys: +0·099 ± ·014, Girls: +0·144 ± ·014.

Now these figures do not indicate a very close association between health and intelligence. Yet such as they are, do they justify us in believing that the medical man can do what the school-teacher fails to achieve, that is modify the intelligence? I fear not. Our data indicated (see p. 5 and Diagrams I^a and I^b, p. 6) that in the fourteen years of life we are dealing with, there is no appreciable change in the average health of our school population. Now that population consisted almost entirely—not of children in the public elementary schools, but—of children in schools for the professional classes from the kindergarten upwards. These children do not lack medical advice, but there is no evidence that there is any improvement in their General Health with age. For our population the medical man does not produce more effect than the teacher in modifying intelligence. It would be of extraordinary interest to ascertain whether the correlation between intelligence and health is higher in the public elementary schools than we have found it in the middle class schools.

---

* Obtained by corrected product moment of a 5 × 3-fold table, the arrays being treated as normal.

If so, there might undoubtedly be a chance that the medical man could improve the intelligence, because medical care is there only too often wanting.

Looked at from the standpoint of our own data Health is responsible for Intelligence in a considerably less degree than a single grandparent is responsible for the character of a grandchild. The relationship is nearer that of great-grandparent and great-grandchild, which is by no means a close association.

It seems to me that our data indicate that Intelligence and Health are given to the child on the average without power of sensible modification. And granted this, our correlations represent the link, not a very close link, that binds the psychical and the physical together in each individual. Where the physical machine is not of the highest order, there the mental machine will on the average run less smoothly, although by no means in complete accord.

(*b*) We now pass to the relation of Health to Conscientiousness.

The correlations found from bi-serial η (see Tables XXI and XXII of Appendix) are:

$$\text{Boys}: +{\cdot}048 \pm {\cdot}015, \quad \text{Girls}: +{\cdot}072 \pm {\cdot}016,$$

and the results are shown graphically in Diagrams XXXII^{a} and XXXII^{b} (p. 49).

The healthy children are very slightly more conscientious, but the relationship is of no importance for prognostication. No sweeping assertion such as that delicate children are usually unconscientious can possibly be made.

(*c*) We consider next Health and Self-Consciousness.

The correlations found from bi-serial η (see Tables XXIII and XXIV of Appendix) are:

$$\text{Boys}: -{\cdot}073 \pm {\cdot}015, \quad \text{Girls}: -{\cdot}087 \pm {\cdot}015,$$

and the results are shown graphically in Diagrams XXXIII^{a} and XXXIII^{b} (p. 50).

There is again very little relationship, the delicate children being slightly more self-conscious.

(*d*) Our next problem is to consider whether the opposed categories of Self-Assertion and Shyness are closely related to Health.

The correlations found from bi-serial η (see Tables XXV and XXVI of Appendix) are:

$$\text{Boys}: +{\cdot}263 \pm {\cdot}014, \quad \text{Girls}: +{\cdot}194 \pm {\cdot}015.$$

Diagrams XXXIV^{a} and XXXIV^{b} (p. 51) represent the results graphically. Here we find a more sensible amount of correlation, the healthy children being more self-assertive.

(*e*) We have already considered the relation of Popularity to Health.

The correlations found from bi-serial η (see Tables XXVII and XXVIII of Appendix) are:

$$\text{Boys}: +{\cdot}199 \pm {\cdot}015, \quad \text{Girls}: +{\cdot}144 \pm {\cdot}015,$$

and the diagrams show that although the relationship is appreciable it is not very intense, and that the Boys lay somewhat more stress on Health than the Girls: see our p. 38 for discussion and Diagrams XXVII^{a} and XXVII^{b} (p. 41).

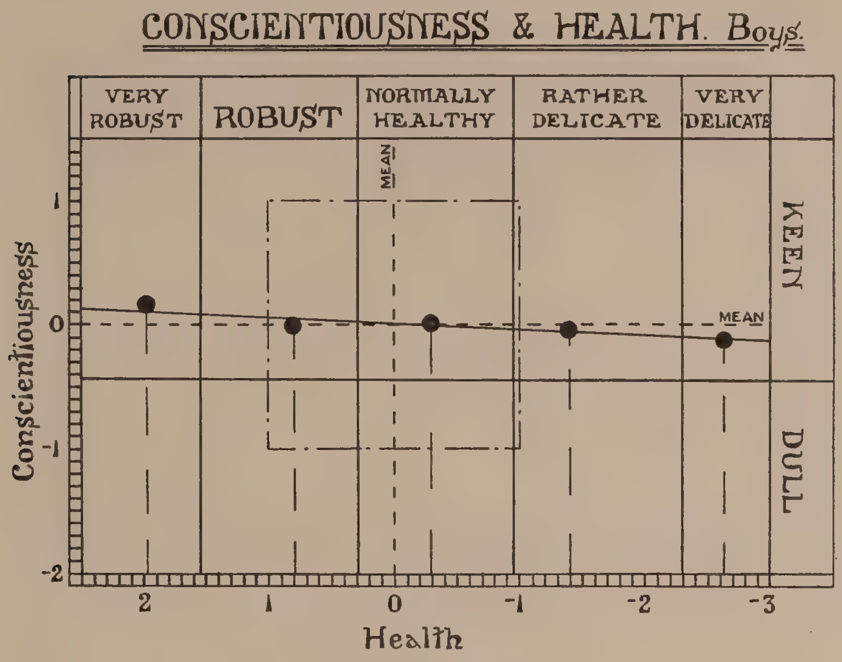

Diagram XXXII^a

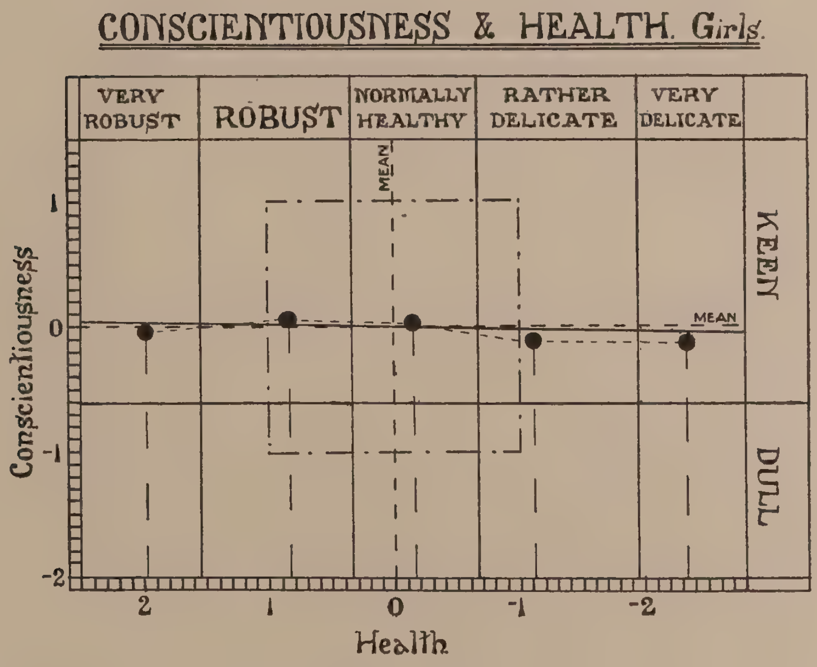

Diagram XXXII^b

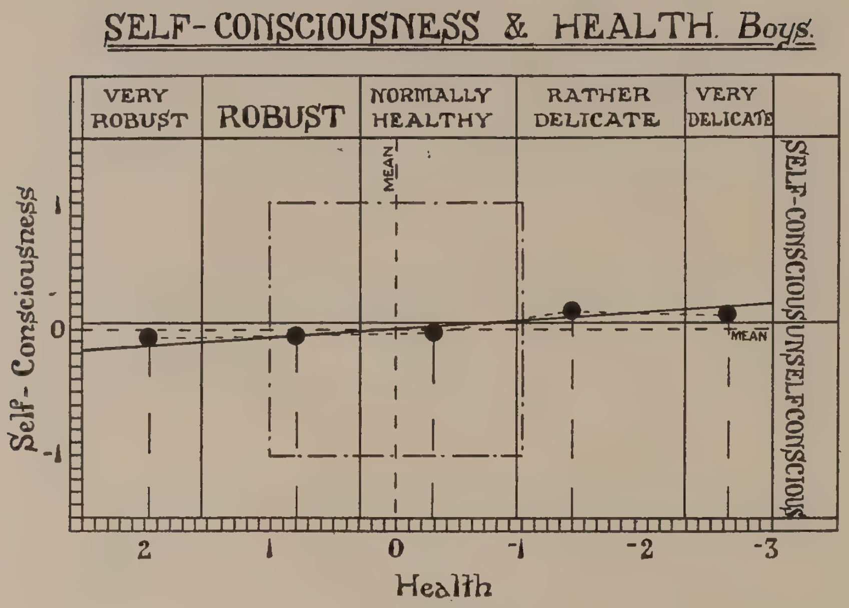

Diagram XXXIII^a

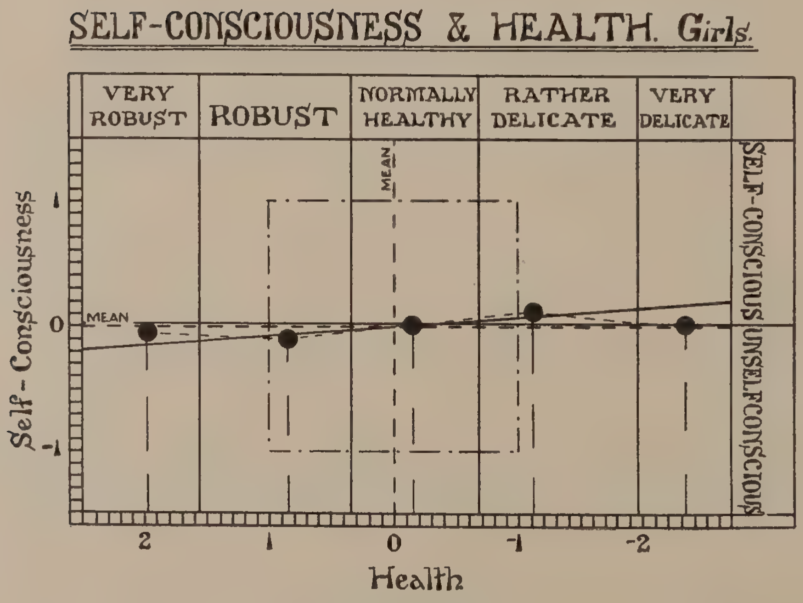

Diagram XXXIII^b

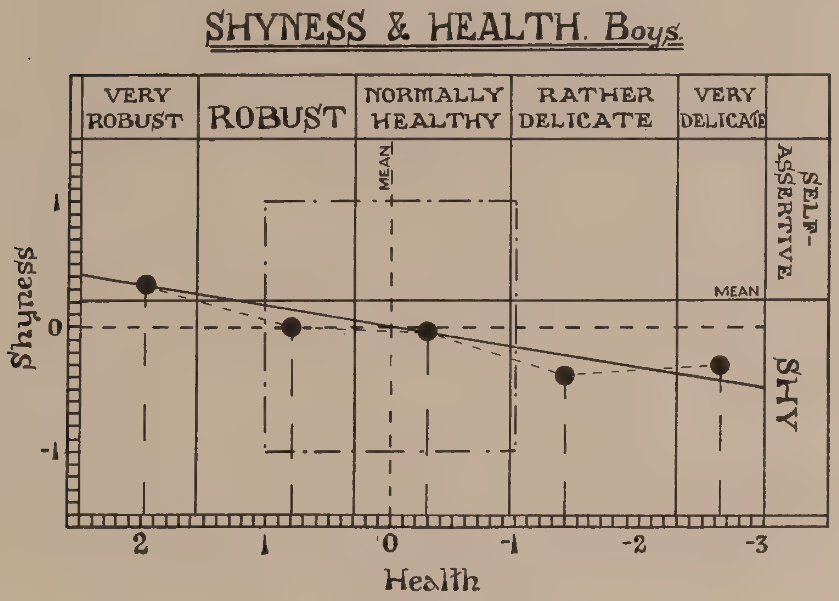

Diagram XXXIV^a

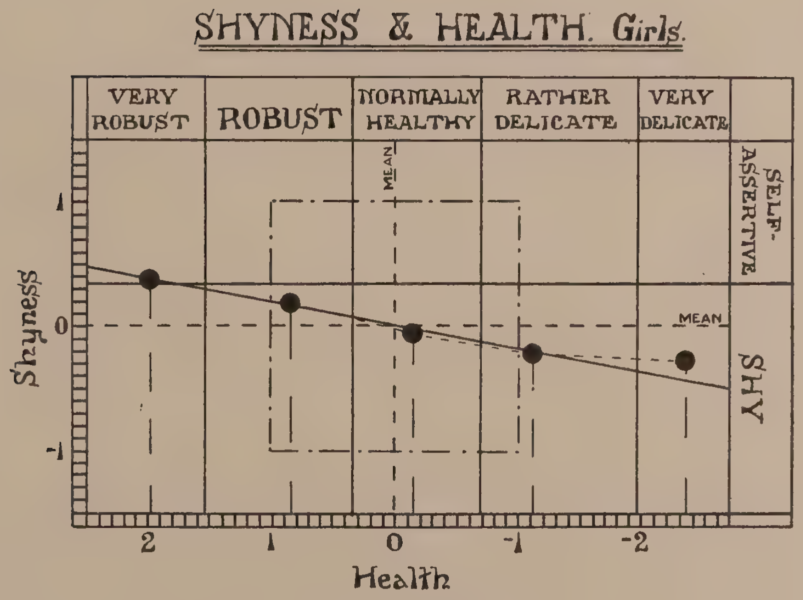

Diagram XXXIV^b

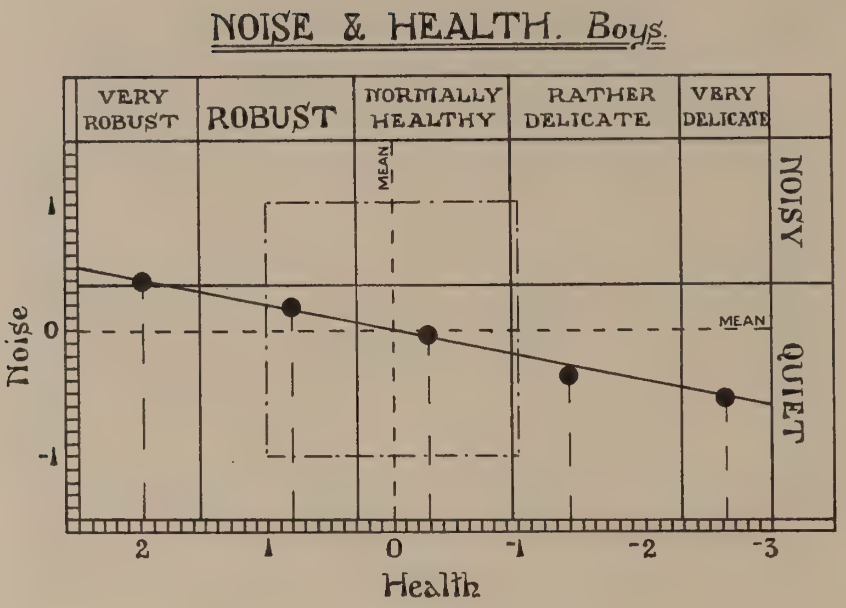
NOISE & HEALTH. *Boys.*

Diagram XXXV^a

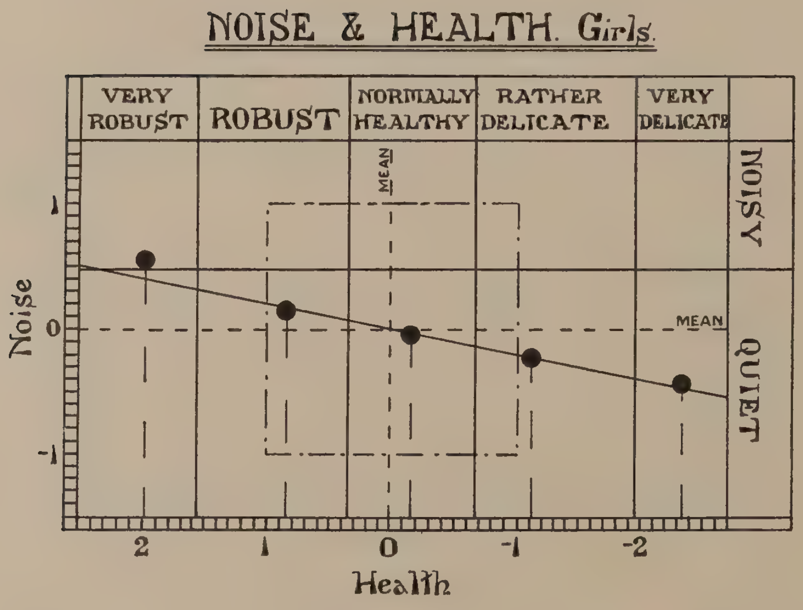
NOISE & HEALTH. *Girls.*

Diagram XXXV^b

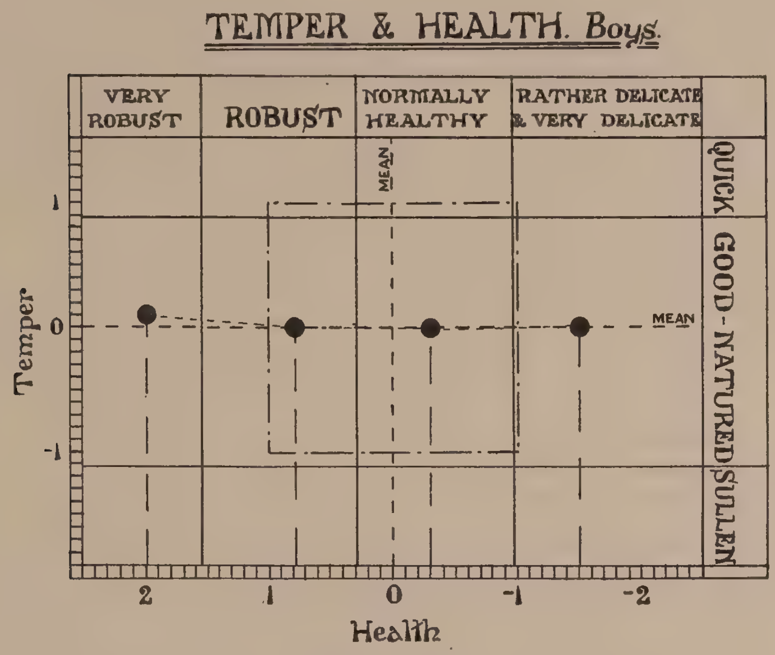

Diagram XXXVI^a

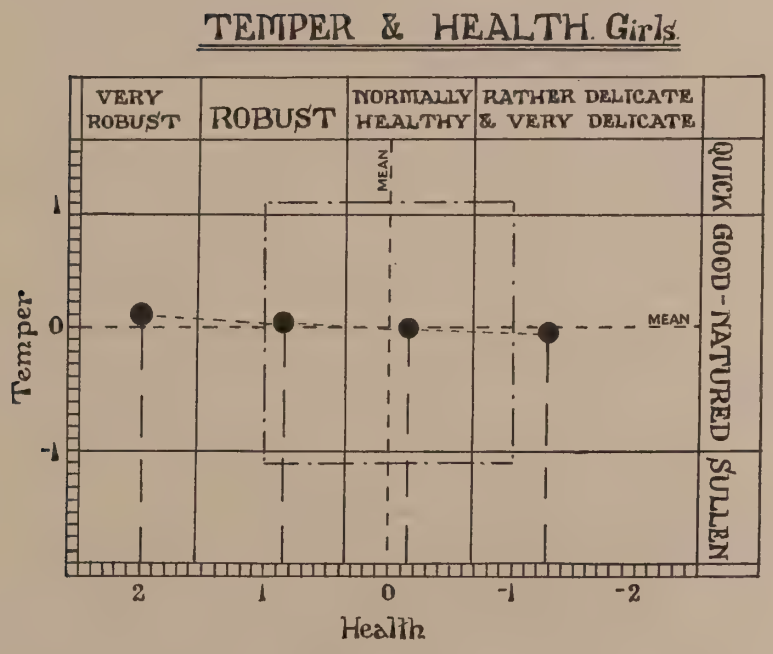

Diagram XXXVI^b

(*f*) We may turn now to the relation of Vivacity (as measured by the noisy and quiet categories) to Health. We find that:

The correlations found by bi-serial η (see Tables XXIX and XXX of Appendix) are:

$$\text{Boys: } +{\cdot}222 \pm {\cdot}014, \quad \text{Girls: } +{\cdot}218 \pm {\cdot}014,$$

and we give the results in graphic form in Diagrams XXXV^{a} and XXXV^{b} (p. 52). The healthier children are the noisier, with a quite sensible, if not very considerable, correlation.

(*g*) Lastly among the purely psychical characters we may study Temper. We may do this in three ways.

(i) By the correlations found by tri-serial η (see Tables XXXI and XXXII of Appendix). These are:

$$\text{Boys: } +{\cdot}031 \pm {\cdot}015, \quad \text{Girls: } +{\cdot}045 \pm {\cdot}014.$$

(ii) By graphs based on the Good-natured Groups taken as a category lying between Quick-tempered and Sullen.

These are given in Diagrams XXXVI^{a} and XXXVI^{b} (p. 53). We see at once that, rather unexpectedly, Temper is not closely associated with Health.

(iii) As some may refuse to admit any continuous variate behind our three categories of temper, we place before the reader an analograph giving the percentages of *Quick-tempered* and *Sullen-tempered* to each class of Health. This is provided in Diagram XXXVII below. We again see that neither Quick-temper nor Sullen-temper

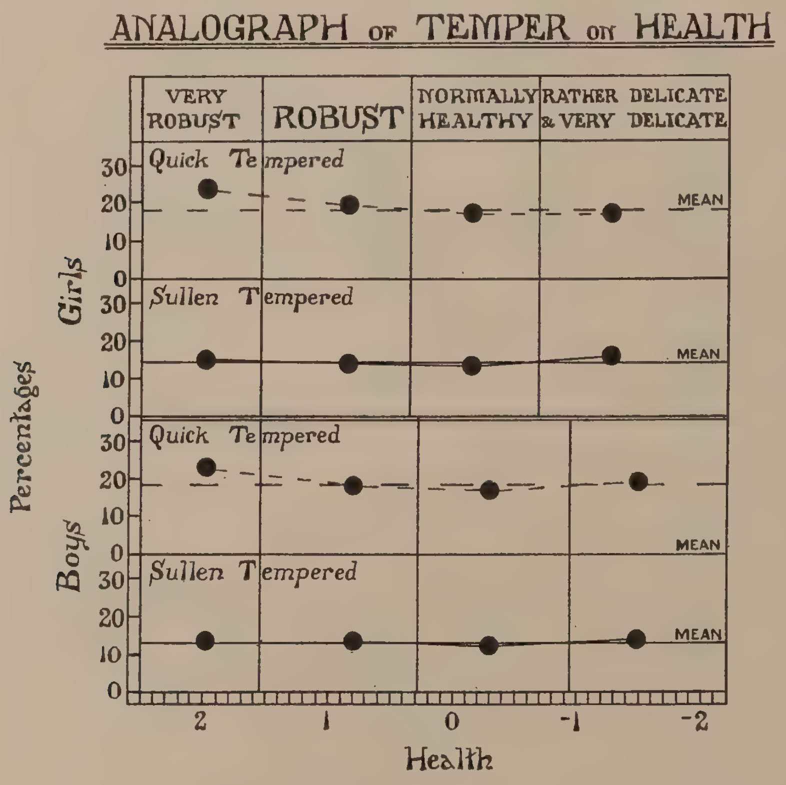

Diagram XXXVII

is significantly associated with health. There is for both Boys and Girls a slight excess of Quick-tempered among the Very Robust and a very slight excess of Sullen-tempered among the Delicate. But no stress can be really laid on these differences.

We now pass to the psycho-physical characters.

(*h*) Let us take first Handwriting and Health.

The correlations* are (see Tables XXXIII and XXXIV of Appendix):

Boys: $+{\cdot}154 \pm {\cdot}015$, Girls: $+{\cdot}103 \pm {\cdot}016$.

The graphs are given in Diagrams XXXVIII^a and XXXVIII^b (p. 56). They indicate that the Normally Healthy boy or girl has about the mean handwriting—a little less in the boy and a little more in the girl. The Very Robust and Robust boys and girls have handwriting superior to the mean, and the Rather Delicate and Very Delicate children have a handwriting below the mean. Handwriting is thus seen to be associated with general Health. The correlation is not very high, but it is quite significant and we may definitely say that a factor of handwriting is physical health. This is an illustration in a permanent phase of the more temporary influence of transient physiological conditions on handwriting, to which I have previously referred (p. 19), and which I think is specially marked in women. It is the Girls here who exhibit the higher correlation.

(*i*) Our other psycho-physical character is Athletic Power. Here the correlations with Health, found by bi-serial η (see Tables XXXV and XXXVI of Appendix), are:

Boys: $+{\cdot}443 \pm {\cdot}013$, Girls: $+{\cdot}397 \pm {\cdot}014$.

Diagrams XXXIX^a and XXXIX^b (p. 57) indicate a quite influential relation—such as we might anticipate—between Health and Athletic Power. The regression is closely linear.

(9) I next endeavoured to ascertain whether Health was correlated to any marked extent with external statical anthropometric characters.

(*a*) Dealing with the Hair I formed a fourfold table, Red and Fair as against Brown and Dark; Robust and Normally Healthy as against Delicate. The correlations were found to be (see Tables XXXVII and XXXVIII of Appendix):

Boys: $+{\cdot}048 \pm {\cdot}026$, Girls: $+{\cdot}088 \pm {\cdot}024$,

those with more pigment being slightly the healthier. The correlations are so small that a more detailed analysis did not seem likely to be profitable.

(*b*) The relation of set of hair (Smooth, Wavy, Curly) was determined by a corrected three-rowed η (see Tables XXXIX and XL of Appendix). The correlations are:

Boys: ${\cdot}041 \pm {\cdot}015$, Girls: ${\cdot}050 \pm {\cdot}015$.

It would not appear that the set of the hair has any value as a sign of general health.

(*c*) Eye colour was next dealt with (see Tables XLI and XLII of Appendix), proceeding by a tetrachoric table; light eyes were taken as against medium and dark, and the Robust contrasted with the remainder.

---

* Obtained by corrected product moment of a 5 × 3-fold table, the arrays being treated as normal.

HEALTH & HANDWRITING. *Boys.*

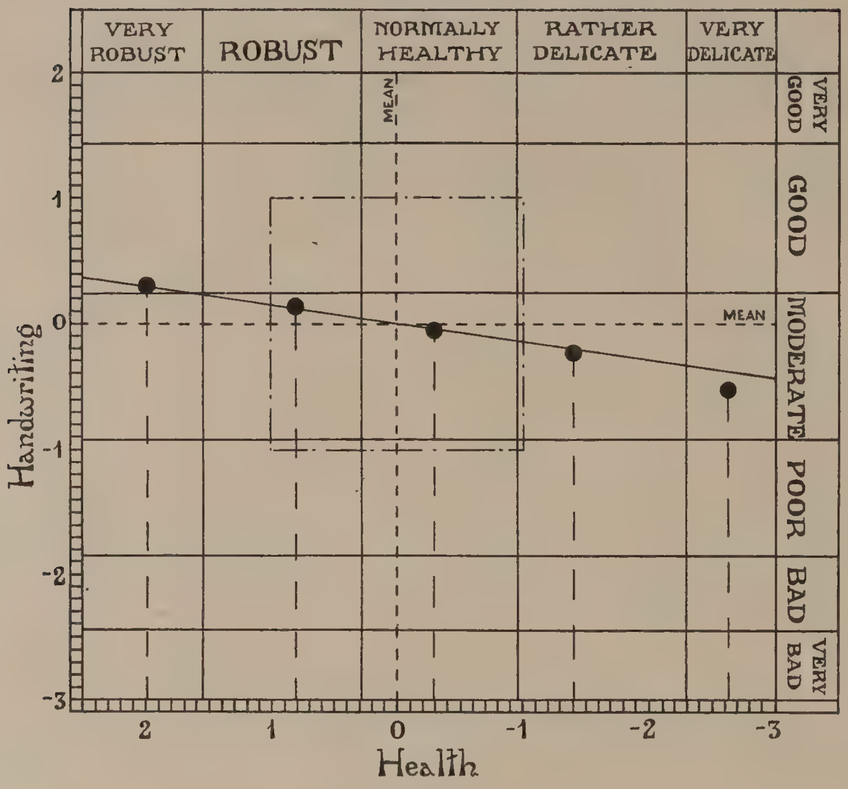

Diagram XXXVIII^a

HEALTH & HANDWRITING. *Girls.*

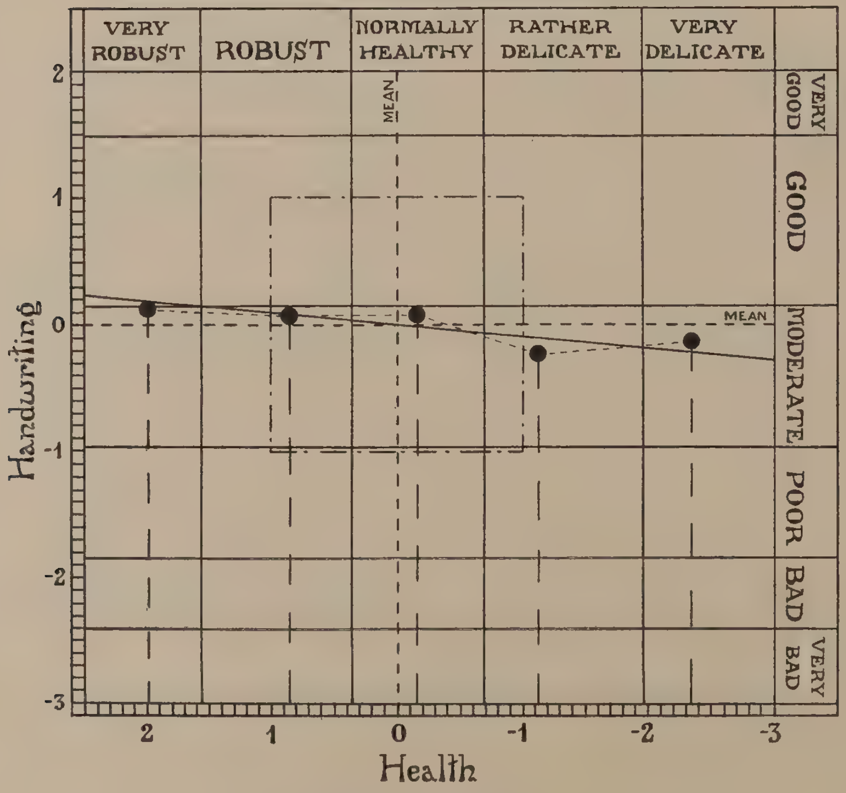

Diagram XXXVIII^b

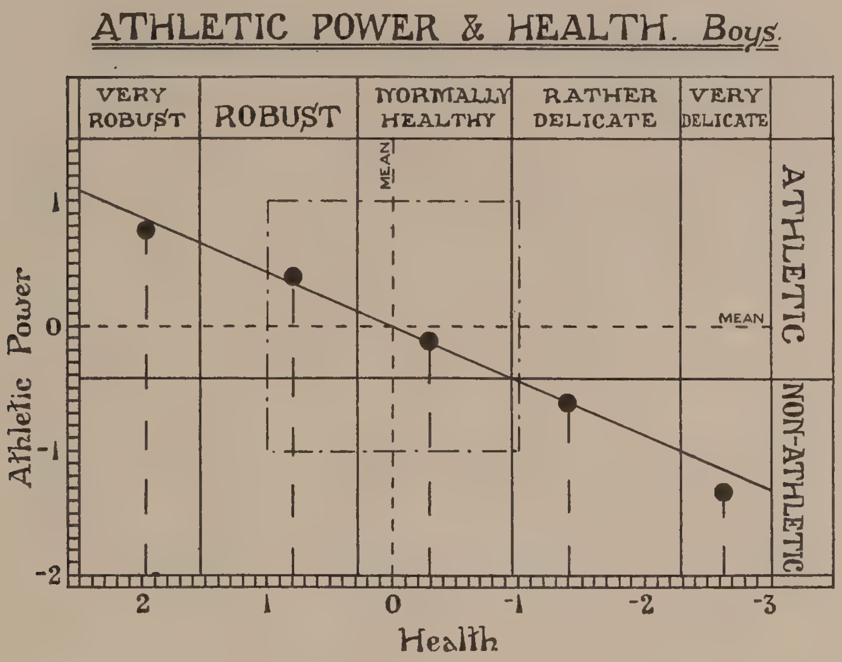

Diagram XXXIX^a

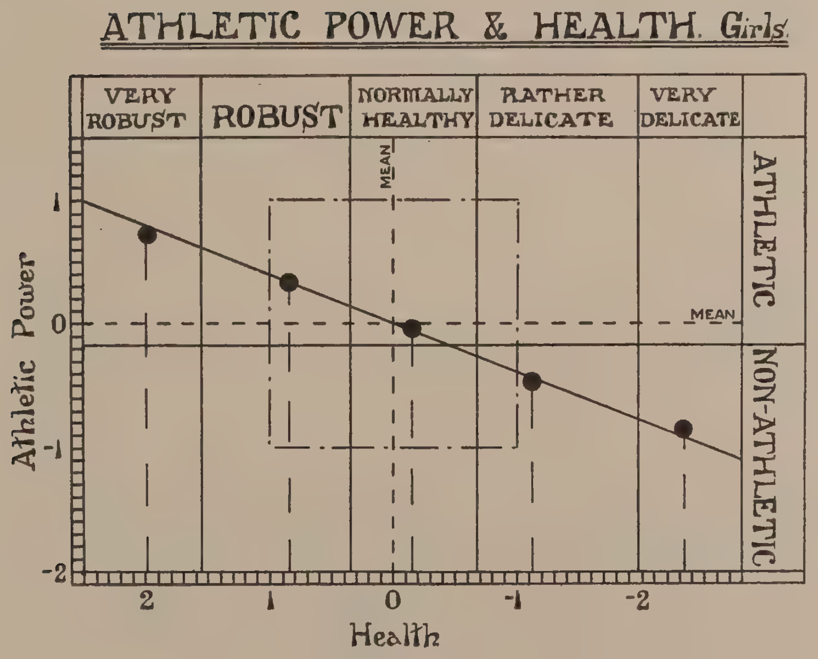

Diagram XXXIX^b

The correlations found were:

Boys: +·074 ± ·023, Girls: +·026 ± ·023.

The more robust having, at any rate in girls, insignificantly more pigment. Again the relationship is too slight to warrant closer analysis.

(*d*) We now considered size of head, reducing by the average growth curve all measurements to a standard age of 12 years. The following tables of the means of three head measurements and of the cephalic index for each category of Health indicate how little relation Health has to that racial characteristic, size and shape of head (see Tables XLIX—LVI).

Table θ

	Length of Head	Breadth of Head	Auricular Height	Cephalic Index
Boys				
Very Robust ...	185·08	145·47	128·25	78·80
Robust	184·79	145·47	127·70	78·80
Normally Healthy ...	184·36	145·21	127·24	79·00
Rather Delicate ...	183·86	144·72	126·6	78·78
Very Delicate ...	182·14	143·02	128·09	78·56
Whole Population ...	184·44	145·20	127·36	78·88
Girls				
Very Robust ...	179·92	140·75	124·69	78·76
Robust	180·58	140·88	124·68	78·48
Normally Healthy ...	179·87	140·21	124·41	78·30
Rather Delicate ...	179·61	140·06	123·92	78·32
Very Delicate ...	179·85	139·76	122·00	77·74
Whole Population ...	180·03	140·40	124·34	78·37

The corresponding correlations* are:

Table ι

	Boys	Girls
Length of Head at 12 years ...	+ ·069 ± ·014	+ ·064 ± ·014
Breadth of Head at 12 years ...	+ ·065 ± ·014	+ ·058 ± ·014
Auricular Height at 12 years ...	+ ·069 ± ·014	+ ·076 ± ·014
Cephalic Index (Health and Brachycephaly)	+ ·018 ± ·014	+ ·044 ± ·014

The greater health of the brachycephalic cannot be considered really significant. The healthier have, however, rather larger heads. Is this an indication of their crania being at a given age slightly larger? I think not; the difference between the Very Robust and the Very Delicate for any head measurement is only 2 to 3 mm., and in auricular height is only about 1·5 mm. I suggest that the Very Robust have on the average more flesh covering their skulls—as they have elsewhere—than the Very

---

* Correlation ratios corrected for class indices.

Delicate and that this might easily amount to 1 to 1·5 mm. in thickness. As in hair and eye characters, so in size and shape of the head I do not think we can really trace any racial characteristic bearing on Health.

I think we must conclude that within the limits of the climate of our own country racial differences in pigmentation and cranial size and shape have very slight influence on Health. In fact I doubt whether any statical external anthropometric characters* are of the smallest importance from the standpoint of health. We must turn rather to dynamic internal characters, to the measurement of the functioning of various organs, in order to obtain characters which are more highly correlated with general health. More than one such inquiry is now on foot, but they cannot be considered on the present occasion.

(10) In the following table I have collected all our correlations of Health with the psychical and physical characters.

TABLE κ

Correlations of Health with Various Psychical and Physical Characters.

	Character	Boys	Girls
Psychical Characters	General Intelligence	+ ·099 ± ·014	+ ·144 ± ·014
	Conscientiousness	+ ·048 ± ·015	+ ·072 ± ·016
	Self-Consciousness	− ·073 ± ·015	− ·087 ± ·015
	Self-Assertion	+ ·263 ± ·014	+ ·194 ± ·015
	Popularity	+ ·199 ± ·015	+ ·144 ± ·015
	Vivacity	+ ·222 ± ·014	+ ·218 ± ·014
	Temper	+ ·031 ± ·015	+ ·045 ± ·014
Psycho-Physical Characters	Handwriting	+ ·154 ± ·015	+ ·103 ± ·016
	Athletic Power	+ ·443 ± ·013	+ ·397 ± ·014
Extended Physical Characters	Hair Colour (Intensity of Pigment)	+ ·048 ± ·026	+ ·088 ± ·024
	Set of Hair (Smooth, Curly, Wavy)	+ ·041 ± ·015	+ ·050 ± ·015
	Eye Colour (Intensity of Pigment)	+ ·074 ± ·023	+ ·026 ± ·023
	Length of Head (at 12 years)	+ ·069 ± ·014	+ ·064 ± ·014
	Breadth of Head "	+ ·065 ± ·014	+ ·058 ± ·014
	Auricular Height "	+ ·069 ± ·014	+ ·076 ± ·014
	Cephalic Index (Health and Brachycephaly) ...	+ ·018 ± ·014	+ ·044 ± ·014

Confining ourselves to the psychical and psycho-physical characters, we see that with the exception of Athletic Power there is no character which approaches to a medium correlation with Health.

If we hold as, I think, we ought reasonably to hold in view of the work published, that in the middle classes both General Health and General Intelligence are hereditary characters, then it follows that the relation, small but significant, which we find between Health and Intelligence is a physiological link, the *mens sana* can only function efficiently *in corpore sano*. But the relation is not a very close one; delicacy does not necessarily connote poor intelligence. Health has but a trifling relation to Conscientiousness, the healthy being very slightly more conscientious. Almost as small is the relation of Delicacy to Self-consciousness. Most noteworthy is the fact shown by our data that Temper is not highly correlated with Health, the healthy children being very slightly more quick-tempered. In a modest degree healthy children are self-assertive, popular and noisy, but even in these characteristics there are no marked relationships. We should naturally anticipate that good coordination of brain and muscle would arise with a healthy child; this view is confirmed in a very moderate sense by Handwriting, the healthy child is a better handwriter than the delicate, and of course, as we have seen, is considerably better at Athletics. Probably the reason the psycho-physical characters have not still higher correlations with Health is that the health of the brain is only a small part of the general bodily health, and thus Health and Intelligence are not highly correlated. Nature selects for physique and she selects for intelligence, but her selection in the past has been rather an alternative, than a combined selection. The eugenist desires a selection which will combine both.

---

* I venture to think that even the importance of *actual* weight—as distinguished from *change* in weight—has been much over-estimated as a factor of health. I should not anticipate that the correlation of weight and general health would exceed ·4.

Taking an all-round view of the matter, it is surprising how small is the relationship of general health to the psychical characters. It would seem that far too much weight has been attributed to the health factor in dealing with mental characteristics. I believe a large part of this exaggerated view of health has been due to its study in public elementary schools. In such schools apparent health may not represent hereditary health; that may be modified by defective environment, by want of medical care and even deficiency of food. Our data from middle-class schools are free from such interfering factors. At the same time it is well within the bounds of possibility that those who attribute bad health and bad intelligence the one to the other, and both to bad care and bad environment, may be overlooking that feebleness in health and feebleness in intelligence are too apt to arise from degeneracy in parents, and that the primary public elementary school is precisely where we should expect to find both concentrated.

(11) Our data for a more normal state of affairs than is to be found in public elementary schools seem to shatter three widely if not universally accepted beliefs. Firstly: General Intelligence and a variety of psychical characters seem practically to be unchanged throughout the whole range of school life. It is not therefore possible for the teacher to modify them. It is the parent, not the teacher, who provides the metal: all the teacher can do is to give it an edge and temper it. Secondly: General Health changes exceedingly little during the whole school period. Health and Intelligence are correlated, although not very markedly. While recognising this association of Health and Intelligence, it does not seem feasible with the present state of medical knowledge to improve Intelligence by modifying health. In the middle classes where environmental and medical care of children is the rule we do not find any appreciable advance in Health during school years. We are forced to recognise that on broad lines Health and Intelligence are innate characters, chiefly controlled by inheritance. Thirdly: There appears to be no foundation for the widely spread opinion that Health is a governing factor of temperament. It is associated but

only in a minor degree with certain psychical characters, with Temper practically not at all. It is quite true that opposed to the three beliefs we have just referred to, there is another opinion held by a somewhat small group of individuals that genius is a sport almost invariably associated with an unhealthy constitution. The argument in favour of this opinion is generally based on the selection of a very limited number of cases favourable to the propounder's view, and the neglect of all other data. Intelligent children at any rate seem to have slightly more than the average health and athletic power. It may indeed be questioned whether the beliefs and opinions we have referred to are not part of those too numerous impressions which mankind readily accepts without asking for the evidence on which they are based. After all there is only one true method for progress in scientific knowledge. It is scepticism as to all current statements and 'explanations,' followed by independent observation, by self-criticism and constructive imagination; these four steps—not trust in authoritative opinion, which is often another name for opinionated authority—are the four fundamental stages in all really creative science. The enthusiastic among teachers have claimed that by education, and the sanguine among medical men have asserted that by improving health, it is possible to modify the psychical characters of children*. Neither claim nor assertion seems justified by the cold statistical light of our present data.

Beneath the ceaseless flow of life the feeble mind of man catches now and again some glimpse of deep biological purpose in the universe; he sees it mid the shifting vortices of the flood only too obscurely. Nature does not work through man but on man; and she works not with his ineffectual tools, but with her own all-powerful machinery. She made by variation, by inheritance, and by ruthless extermination the moderately amiable, the moderately intelligent man of to-day out of an untamed and mordacious precursor. Is it not blind audacity for man to claim that by aid of his puny, if undoubtedly useful, little polishing tools, such as education and medicine, he can achieve as much in a school life as Nature with her omnipotent mechanism has taken in all probability a quarter of a million years to produce? If man would throw himself into sympathy with Nature's purpose, let him appreciate to the full extent the potency of her methods, and endeavour as his slender strength may permit to use her tools.

---

* Some portion of this memoir was delivered as a lecture on Dec. 9, 1922, to the teachers of the London County Council Schools, and rather garbled extracts from it appeared in the press. One critic cited as evidence against my contention that the psychical characters are innate, the consensus of opinion that boys trained in different English public schools bear well-marked differences of character, and he considered that this was due to the difference of training in the schools. A certain proportion of this differentiation is superficial mannerism, which largely wears off in after life, but there is a remainder which is undoubtedly real. Eton and Rugby are very easily distinguished from each other, but then one often meets Rugby and Eton boys who have never been to school in either Rugby or Eton; and what is more the Oppidan is as markedly different from the Colleger as he is from the Rugbeian! The fact is my critic has overlooked the point that certain groups in the community, markedly differentiated in character from each other, traditionally send their sons to one or other of the great public schools. Generation by generation the same families send their sons to the same schools. The views of some great headmaster may have originally attracted a certain type in the community; but he only concentrated the type. The appeal of Rugby is to the lesser squirearchy and to the professional man, especially the barrister and country solicitor. It used to be the highest ambition of the country clergyman—especially if he held a family living—to have his son in College at Eton, while the Oppidans were recruited from a higher social, or at least a more monied class than the Rugbeians or Eton Collegers. Such points as these, I think, my critic was overlooking.

(12) *Conclusion.* A few words may be fittingly said here as to the history of this memoir. The work on it was started in 1904 immediately after the preparation of my Huxley Lecture "On the Inheritance of the Mental and Moral Characters in Man."* The data for Health were then tabulated chiefly by Dr Alice Lee, and some of the correlations worked out by her have been used in this paper. But the work was put on one side, although announced for publication in 1905, owing to the rapid progress made about that time in statistical methods, which involved redoing many of the calculations. The opportunity for returning to the matter never came for seventeen years! In the autumn of last year I was asked to give a lecture to the school-teachers of London† and chose as my topic the influence of the health of the school-child on its psychical characters. The work had to be done rapidly, but with the strenuous assistance of my colleagues, Miss Ethel M. Elderton and Miss Margaret Moul, many new tables were formed, the old work largely recomputed, and rough drafts made for Miss Ida McLearn's finished diagrams for the epidiascope. It is these diagrams somewhat reduced which I venture to think form the most valuable part of the present paper. It is quite true that in this memoir I have said very little more than I was familiar with in 1904, and that familiarity has tempered all my views on education since. But it is very doubtful whether this memoir would ever have reached publicity had not Sir Robert Blair invited me to lecture to the London County Council teachers; and I am quite certain that neither lecture nor memoir would ever have been completed had not my aforementioned colleagues so generously put aside their own researches to aid me. To them therefore the reader is really indebted for such interest as he may find in a perusal of these pages. One further word of thanks I must add: I should like to express once more the great sense of gratitude I feel to the body of teachers who in 1898—1903 aided me in collecting the present material; they were a selected group of high intelligence, and the manner in which they performed their arduous task has been more and more impressed upon me by a comparison of the returns they made with those produced by more recent school inquiries. There is a statistical regularity and concordance in their returns which is evidence of the conscientiousness with which they worked, and is in striking contrast to the haphazard character of much school data of more recent date.

---

* *Biometrika*, Vol. III. pp. 131—190.

† Actually delivered December 9, 1922.

APPENDIX. *Tables of Data.*

Change of Character with Age

Table Number	Sex		Character	Age in years																Totals
				4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
I	Boys	Health	Very Robust	—	1	2	5	9	14	14	19	18	16	12	9	10	6	7·5	1	143·5
			Robust	2	9	10	28	48	62	74	114	89	107	82·5	60·5	47	23·5	12	8	776·5
			Normally Healthy	4	8	17	36	68	84	105·5	124	156·5	147	107·5	96	57	33	17·5	2	1063
			Rather Delicate	—	2	10	18	30	34	45·5	40	42·5	54	36	30·5	18	11·5	4	2	378
			Very Delicate	—	—	—	2	—	3	2	3	2	9	5	1	—	—	—	—	27
			Totals	6	20	39	89	155	197	241	300	308	333	243	197	132	74	41	13	2388
II	Girls		Very Robust	—	2	4	3	6	14	14	11	16	11	11·5	16	14	8	3	1	134·5
			Robust	4	7	12	23	36	58	69	93	96	81	65·5	50	44·5	24	22	5	690
			Normally Healthy	2	8	15	35	45	72	95	107	117·5	114	83	85·5	58	33	26·5	5	901·5
			Rather Delicate	1	3	7	16	28	43	43	60	58·5	60·5	44	52·5	44·5	28	15·5	3	507·5
			Very Delicate	—	—	2	3	2	—	7	6	9	8·5	7	8	3	1	—	—	56·5
			Totals	7	20	40	80	117	187	228	277	297	275	211	212	164	94	67	14	2290
III	Boys	Intelligence	Quick Intelligent	1	2	6	19	20	24	33	35	39	27	29	16	14	9	3	2·5	279·5
			Intelligent	2	5	12	25	60	57	76·5	96·5	110	107·5	84	66·5	39	24	16·5	5·5	787
			Slow Intelligent	1	5	15	25	39	60	72·5	105	120·5	108·5	70	68·5	43	24	11·5	2	770·5
			Slow	2	4	4	4	30	34·5	35	42·5	51	57·5	39·5	19	28	8	8	2	369
			Slow Dull	—	1	3	6	7	7·5	21	11	12·5	25·5	16	16	9	4	—	—	139·5
			Very Dull	—	—	—	4	—	6	2	5	3	11	3·5	2	2	3	—	—	41·5
			Totals	6	17	40	83	156	189	240	295	336	337	242	188	135	72	39	12	2387
IV	Girls		Quick Intelligent	1	4	7	16	20	20	27	38	44	38	32·5	22	19	18·5	14	2	323
			Intelligent	5	5	13	27	40	74	91	106·5	106·5	93	64	64·5	48	34·5	20·5	3	795·5
			Slow Intelligent	—	9	14	20	33	61	69	90·5	84·5	80	60	75	54	21	14·5	4	689·5
			Slow	—	1	4	6	15	22	23	23	36	40	29·5	33·5	27	8	10	3	281
			Slow Dull	—	—	3	6	4	7	9	10	18	10	13	13	7	8	5	—	113
			Very Dull	—	—	—	2	2	2	3	4	5	3	4	7	4	2	1	—	39
			Totals	6	19	41	77	114	186	222	272	294	264	203	215	159	92	65	12	2241

APPENDIX. *Tables of Data (continued).*

Change of Character with Age

Table Number	Sex		Character	Age in years																Totals
				4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
V	Boys	Handwriting	Very Good	—	—	2	3	9	10	6	31	23	31	12·5	10	6	3	3	1	150·5
			Good	1	5	10	27	45	59	80	97·5	114·5	76·5	63	48·5	17·5	11	9	2	666·5
			Moderate	2	4	12	35	67	74·5	90·5	94	120·5	114	75·5	58·5	39·5	25	6	3	821
			Poor	—	1	4	12	18	27·5	29·5	33	25	39·5	35	20	17	9	2	—	272·5
			Bad	—	1	1	1	—	6	7	7·5	6	7	4	5	1	1	1	—	48·5
			Very Bad	—	—	—	2	1	2	2	1	1	4	2	—	—	1	—	—	16
			Totals	3	11	29	80	140	179	215	264	290	272	192	142	81	50	21	6	1975
VI	Girls		Very Good	—	1	2	2	4	9	16	10	13	16	12	13	9	5	4	—	116
			Good	—	4	13	23	40	60	83	89	112·5	82	55·5	46	35	15·5	15	3	676·5
			Moderate	—	2	8	29	36	67	64	90	89·5	82	57·5	76	56	29·5	22	4	712·5
			Poor	—	1	3	11	12	19	22	28	21	28	25	29	22	17	10	3	251
			Bad	—	—	—	—	3	3	2	1	2	9	6	9	5	7	1	1	49
			Very Bad	—	—	—	—	—	2	1	5	1	2	1	1	2	—	—	—	15
			Totals	—	8	26	65	95	160	188	223	239	219	157	174	129	74	52	11	1820
VII	Boys	Athletic Power	Athletic	3	3	9	34	61	84	116	150	168	155	120	103	81	39	28	8	1162
			Betwixt	—	—	—	—	1	5	7	10	9	11	11	13	16	4	—	—	87
			Non-Athletic	—	2	9	17	39	51	53	56	80	83	71	55	25	22	7	4	574
			Totals	3	5	18	51	101	140	176	216	257	249	202	171	122	65	35	12	1823
VIII	Girls		Athletic	4	4	14	24	44	70	79	100	125	113	96	98	64	47	30	—	912
			Betwixt	—	—	—	—	—	—	—	1	2	7	9	8	6	8	4	—	45
			Non-Athletic	—	1	6	17	23	43	65	78	90	81	72	72	75	30	25	—	678
			Totals	4	5	20	41	67	113	144	179	217	201	177	178	145	85	59	—	1635

Table Number	Sex		Character	Age in years 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Totals
IX	Boys	Conscientiousness	Keen	2	5	14	43	79	95	117	163	168	165	121	107	72	39	18	6	1214
			Betwixt	—	—	7	6	22	29	32	23	43	30	36	20	13	8	7	1	277
			Dull	3	1	8	20	31	50	65	76	78	89	49	30	22	11	6	1	540
			Totals	5	6	29	69	132	174	214	262	289	284	206	157	107	58	31	8	2031
X	Girls		Keen	5	10	19	43	61	102	131	141	161	164	102	131	98	59	55	9	1291
			Betwixt	—	—	3	4	10	15	18	23	27	22	26	28	19	12	8	1	216
			Dull	—	2	6	16	21	39	45	73	60	49	41	33	26	11	3	4	429
			Totals	5	12	28	63	92	156	194	237	248	235	169	192	143	82	66	14	1936
XI	Boys	Self-consciousness	Self-conscious	2	7	9	25	51	59	92	117	122	120	76	74	42	28	14	5	843
			Betwixt	—	—	3	4	15	19	24	20	30	27	27	13	18	6	5	1	212
			Unself-conscious	3	4	15	36	54	92	96	115	136	131	92	73	43	21	11	3	925
			Totals	5	11	27	65	120	170	212	252	288	278	195	160	103	55	30	9	1980
XII	Girls		Self-conscious	2	5	18	33	41	69	87	103	106	108	87	96	67	35	31	6	894
			Betwixt	—	1	1	—	3	7	12	5	16	17	13	16	17	14	5	—	127
			Unself-conscious	2	7	10	32	50	72	98	127	128	113	70	78	58	38	28	6	917
			Totals	4	13	29	65	94	148	197	235	250	238	170	190	142	87	64	12	1938
XIII	Boys	Self-assertion	Self-Assertive	5	4	12	24	38	65	87	109	100	101	61	32	39	19	4	2	702
			Betwixt	1	—	4	6	25	28	33	26	48	32	28	23	20	10	7	1	292
			Shy	1	8	17	40	74	81	95	127	133	145	115	101	43	30	20	5	1035
			Totals	7	12	33	70	137	174	215	262	281	278	204	156	102	59	31	8	2029
XIV	Girls		Self-Assertive	3	4	11·5	24	32	48	59·5	76	78·5	77·5	61·5	54·5	38	27	12	2	609
			Betwixt	—	2	2	5	8	15	19	22	23	28	23	24	21	17	9	—	218
			Shy	1	7	19·5	42	62	88	119·5	133	155·5	123·5	90·5	113·5	78	33	39	8	1113
			Totals	4	13	33	71	102	151	198	231	257	229	175	192	137	77	60	10	1940

APPENDIX. *Tables of Data (continued).*

Change of Character with Age

Table Number	Sex		Character	Age in years 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Totals
XV	Boys	Temper	Quick	1	3	5·5	17	24	32·5	45·5	66	60·5	56	43·5	26·5	19	15	5·5	1	421·5
			Good-natured	4	11	26	55	109	131·5	160	178	213	209	148·5	121	79	42	25·5	7	1519·5
			Sullen	2	2	6·5	12	19	25	32·5	34	39·5	43	24	24·5	11	9	3	1	288
			Totals	7	16	38	84	152	189	238	278	313	308	216	172	109	66	34	9	2229
XVI	Girls		Quick	3	2	9	10	25	35	37·5	45	41·5	50·5	41	33	34	16	11	1·5	395
			Good-natured	3	13	20	55·5	80·5	123	148	183·5	205	174	128	149	100·5	60	47·5	8·5	1499
			Sullen	1	3	6	9·5	9·5	25	37·5	40·5	46·5	39·5	32	32	24·5	14	7·5	3	331
			Totals	7	18	35	75	115	183	223	269	293	264	201	214	159	90	66	13	2225
XVII	Boys	Vivacity (noise)	Noisy	6	7	8	29	36	65	97	96	102	106	65	40	40	18	8	2	725
			Betwixt	1	—	6	8	22	19	24	22	26	15	16	9	11	5	3	—	187
			Quiet	1	11	23	47	91	109	114	162	189	187	140	124	62	47	25	9	1341
			Totals	8	18	37	84	149	193	235	280	317	308	221	173	113	70	36	11	2253
XVIII	Girls		Noisy	5	9	11	25	37	57	70	80	75	72	67	55·5	39	22	11	3	638·5
			Betwixt	—	1	1	3	9	7	15	17	15	19	15	16	11	13	5	1	148
			Quiet	1	7	26	50	68	120	136	174	203	177	113	141·5	113	52	50	9	1440·5
			Totals	6	17	38	78	114	184	221	271	293	268	195	213	163	87	66	13	2227
XIX	Boys	Popularity	Popular	5	7	18	54	85	127	136	178	186	178	130	94	70	32	20	5	1325
			Betwixt	1	—	11	8	38	33	46	45	62	54	39	37	30	13	8	3	428
			Unpopular	—	1	1	6	7	14	15	23	20	28	18	17	5	12	2	2	171
			Totals	6	8	30	68	130	174	197	246	268	260	187	148	105	57	30	10	1924
XX	Girls		Popular	3	9	23	46	69	119	145	173	183	169	104	105	85	48	41	8	1330
			Betwixt	—	3	4	10	16	24	26	24	43	36	37	45	33	23	12	4	340
			Unpopular	—	1	3	5	7	13	18	32	21	18	20	26	16	9	7	1	197
			Totals	3	13	30	61	92	156	189	229	247	223	161	176	134	80	60	13	1867

APPENDIX. *Tables of Data* (*continued*).

Health and Psychical Characters

Table Number	Sex		Character	Health					Totals
				Very Robust	Robust	Normally Healthy	Rather Delicate	Very Delicate	
XXI	Boys	Conscientiousness	Keen	83	451·5	580·5	215·5	12·5	1343
			Dull	31·5	227	290	116	7·5	672
			Totals	114·5	678·5	870·5	331·5	20	2015
XXII	Girls		Keen	81	415	528·75	275	34·75	1334·5
			Dull	32	140·5	183·25	122	15·75	493·5
			Totals	113	555·5	712	397	50·5	1828
XXIII	Boys	Self-consciousness	Self-conscious	51·5	284·5	409	170·5	11	926·5
			Unself-conscious	62·5	331	453	146	10	1002·5
			Totals	114	615·5	862	316·5	21	1929
XXIV	Girls		Self-conscious	61·5	269	386·5	235·25	25	977·25
			Unself-conscious	68	322	384·5	196·25	25	995·75
			Totals	129·5	591	771	431·5	50	1973
XXV	Boys	Self-assertion	Self-assertive	61	324·25	351·75	86	6·5	829·5
			Shy	49·5	335·75	527·25	240·5	15·5	1168·5
			Totals	110·5	660	879	326·5	22	1998
XXVI	Girls		Self-assertive	62·5	242	260·75	124	15·25	704·5
			Shy	58·5	311	504·25	311·5	42·25	1227·5
			Totals	121	553	765	435·5	57·5	1932
XXVII	Boys	Popularity	Popular	103	539	657	216·5	10·5	1526
			Unpopular	9·5	112·5	159	85·5	8·5	375
			Totals	112·5	651·5	816	302	19	1901
XXVIII	Girls		Popular	103·5	463·75	609·75	313	27	1517
			Unpopular	18	97·75	138·75	100·5	18	373
			Totals	121·5	561·5	748·5	413·5	45	1890

Appendix. *Tables of Data (continued).*

Health and Psychical Characters

Table Number	Sex		Character	Health					Totals
				Very Robust	Robust	Normally Healthy	Rather Delicate	Very Delicate	
XXIX	Boys	Vivacity (noise)	Noisy	65·5	314·75	329·75	82	4	796
			Quiet	68	424·25	637·25	276·5	19	1425
			Totals	133·5	739	967	358·5	23	2221
XXX	Girls		Noisy	75	249·5	262·5	116·75	10·25	714
			Quiet	66	420	619·5	373·25	47·25	1526
			Totals	141	669·5	882	490	57·5	2240
XXXI	Boys	Temper	Quick	31·25	120·75	157	51·5	8	368·5
			Good-natured	82·25	442·75	617·5	196·5	6	1345
			Sullen	17	83·5	109·5	38·5	3	251·5
			Totals	130·5	647	884	286·5	17	1965
XXXII	Girls		Quick	33	130	141·5	81·5	7	393
			Good-natured	83·25	436·25	573·75	317·5	44	1454·75
			Sullen	21·75	99·75	121·75	80	6	329·25
			Totals	138	666	837	479	57	2177
XXXIII	Boys	Handwriting	Very Good	19	61	51·5	15·5	0·5	147·5
			Good	46	221	286·5	83	4·5	641
			Moderate	41·5	247·5	377	140	7	813
			Poor	14	78·5	130	54·5	6	283
			Bad	2	8·5	22	15	—	47·5
			Very Bad	1	—	7	5	1	14
			Totals	123·5	616·5	874	313	19	1946
XXXIV	Girls		Very Good	7	40	58·5	16·5	1	123
			Good	47·5	201	277	130	18	673·5
			Moderate	43·5	204·5	256·5	180·5	14·5	699·5
			Poor	9	59	93	67	9	237
			Bad	3	3	17·5	21·5	1	46
			Very Bad	1	5	1	5	2	14
			Totals	111	512·5	703·5	420·5	45·5	1793

Appendix. *Tables of Data (continued).*

Health and Physical Characters

Table Number	Sex		Character	Health					Totals
				Very Robust	Robust	Normally Healthy	Rather Delicate	Very Delicate	
XXXV	Boys	Athletics	Athletic	91	447·5	497·5	120	3	1159
			Non-Athletic	9·5	98·5	293·5	166·5	16	584
			Totals	100·5	546	791	286·5	19	1743
XXXVI	Girls		Athletic	90	350·25	348·5	140·75	8	937·5
			Non-Athletic	18	144·25	277·5	242·25	26·5	708·5
			Totals	108	494·5	626	383	34·5	1646
XXXVII	Boys	Hair Colour	Red	4·5	34·5	34·5	14·5	9	97
			Fair	51·5	254·25	361·5	131·75	7	806
			Brown	45·5	230·5	349·75	141·75	5	772·5
			Dark	38	209·75	276·75	71·5	3	599
			Jet Black	2	21	14·5	4	1	42·5
			Totals	141·5	750	1037	363·5	25	2317
XXXVIII	Girls		Red	8·5	28	35	20	2	93·5
			Fair	39·5	245	323·5	216·5	19·5	844
			Brown	54	249·5	369	191	27	890·5
			Dark	39·5	160	177	87	12	475·5
			Jet Black	0·5	9	8	2	—	19·5
			Totals	142	691·5	912·5	516·5	60·5	2323
XXXIX	Boys	Hair Set	Smooth	98	588·5	741·5	279	17	1724
			Wavy	22·5	87·75	122·5	43·75	2	278·5
			Curly	5	20·75	35	10·75	5	76·5
			Totals	125·5	697	899	333·5	24	2079
XL	Girls		Smooth	74	421·25	553·75	311	31·5	1391·5
			Wavy	33	157·25	195·25	98	15	498·5
			Curly	27	63	87	69	9	255
			Totals	134	641·5	836	478	55·5	2145
XLI	Boys	Eye Colour	Light	49	263·25	404·75	135	16	868
			Medium	56·5	322·25	410·25	149·5	8	946·5
			Dark	34	171	220·5	64	3	492·5
			Totals	139·5	756·5	1035·5	348·5	27	2307
XLII	Girls		Light	46	229	307·75	193·25	23	799
			Medium	67	301·5	404·25	216·75	27·5	1017
			Dark	35	167	202·5	104·5	14	523
			Totals	148	697·5	914·5	514·5	64·5	2339

Appendix. *Tables of Data (continued).*

Intelligence with other Characters

Table Number	Sex		Character	Intelligence						Totals
				Quick Intelligent	Intelligent	Slow Intelligent	Slow	Slow Dull	Very Dull	
XLIII	Boys	Athletic Power	Athletic	159·5	421·75	355·5	158·75	40·5	12	1148
			Non-Athletic	46	163·25	187·5	99·75	48·5	15	560
			Totals	205·5	585	543	258·5	89	27	1708
XLIV	Girls		Athletic	167·5	369·5	259·5	98·5	32	11	938
			Non-Athletic	74·5	225·5	220·5	122·5	55	18	716
			Totals	242	595	480	221	87	29	1654
XLV	Boys	Popularity	Popular	216·5	548·5	513·75	222·25	69	18·5	1588·5
			Unpopular	25	101·5	132·75	72·25	44	9	384·5
			Totals	241·5	650	646·5	294·5	113	27·5	1973
XLVI	Girls		Popular	253·5	496·75	443·25	150·5	53	12·5	1409·5
			Unpopular	26·5	89·75	113·75	74	36	21·5	361·5
			Totals	280	586·5	557	224·5	89	34	1771
XLVII	Boys	Health	Very Robust	28	46·5	36	19	6	3	138·5
			Robust	77	272·5	266·5	102	42·25	3·25	763·5
			Normally Healthy	120	336·5	313·5	138	56·25	17·75	982
			Rather Delicate	40·5	92	111	76	29·5	14	363
			Very Delicate	5	6	8	2	2	3	26
			Totals	270·5	753·5	735	337	136	41	2273
XLVIII	Girls		Very Robust	31	39·5	39·5	15	5	3	133
			Robust	135·5	256·5	189	74·5	26	9	690·5
			Normally Healthy	106·25	355·25	284	97	39·5	13	895
			Rather Delicate	58·25	142·25	166·5	89·5	37·5	15	509
			Very Delicate	4	19·5	16	11	4	3	57·5
			Totals	335	813	695	287	112	43	2285

APPENDIX. *Tables of Data (continued).*

Health and Head Length reduced to 12 years

TABLE XLIX. TABLE L.

Head Length mm.	Health—Boys						Health—Girls					
	Very Robust	Robust	Normally Healthy	Rather Delicate	Very Delicate	Totals	Very Robust	Robust	Normally Healthy	Rather Delicate	Very Delicate	Totals
158·5–160·5	—	—	—	—	—	—	—	1	1·5	2	—	4·5
160·5–162·5	—	—	—	—	—	—	—	0·5	2	1·5	—	4
162·5–164·5	—	—	1	2	—	3	—	2	1	0·5	1	4·5
164·5–166·5	—	1	1·5	1	1	4·5	2	9	17·5	4	1	33·5
166·5–168·5	—	2	6	1	—	9	0·5	12	17	10	—	39·5
168·5–170·5	1·5	9·5	10	8·5	1	30·5	7·5	13·5	26·5	10	4	61·5
170·5–172·5	2·5	17	28	7	1	55·5	4·5	27	35·5	27·5	1	95·5
172·5–174·5	3	24	28·5	12·5	1	69	8·5	33	57	42	4·5	145
174·5–176·5	3	20·5	52·25	19·25	0·5	95·5	16·5	65·5	87·5	40	7	216·5
176·5–178·5	6·5	45	60·75	31·25	2	145·5	15·5	87·5	96·5	64	8·5	272
178·5–180·5	12	69	87	26·5	4	198·5	21·5	88	125	70·5	6	311
180·5–182·5	13·5	76	101	38	2	230·5	14	80·5	104	55·5	1·5	255·5
182·5–184·5	19	95	138·75	63·25	4	320	11	79	94·5	58	7	249·5
184·5–186·5	16·5	96·25	122	36·25	4	275	9·5	53·5	64	37·5	6	170·5
186·5–188·5	26·5	77·25	98·25	36·5	2	240·5	11	51·5	57	24·5	3·5	147·5
188·5–190·5	7·25	94·25	86	28	1	226·5	9·5	28·5	27	20	3	88
190·5–192·5	9·25	56	73·75	30	2	171	2	21·5	17·5	5	2	48
192·5–194·5	4	34·25	46·25	13·5	—	98	1	5	12·5	5·5	1·5	25·5
194·5–196·5	6	19·5	29	8·5	—	63	—	8	8	4	—	20
196·5–198·5	1	12·75	21·5	3·75	—	39	—	4	4	—	—	8
198·5–200·5	—	6·75	6·5	6·75	1	21	—	1	—	—	—	1
200·5–202·5	—	3	4·5	1	—	8·5	—	—	—	—	—	—
202·5–204·5	—	1	1	1	—	3	—	—	—	—	—	—
204·5–206·5	—	1	2	—	—	3	—	—	—	—	—	—
Totals	141·5	761	1005·5	375·5	26·5	2310	134·5	671·5	855·5	482	57·5	2201

APPENDIX. *Tables of Data* (*continued*).

Health and Breadth of Head

TABLE LI.

Head Breadth in mm.	Boys' Health					
	Very Robust	Robust	Normally Healthy	Rather Delicate	Very Deli-cate	Totals
113·5–115·5	—	—	—	—	—	—
115·5–117·5	—	—	—	—	—	—
117·5–119·5	—	—	—	—	—	—
119·5–121·5	—	—	—	—	—	—
121·5–123·5	—	—	1	—	—	1
123·5–125·5	—	—	1	—	1	2
125·5–127·5	—	1	—	—	1	2
127·5–129·5	1	7	2	2	—	12
129·5–131·5	2	5	9	4	1	21
131·5–133·5	2	4	17	7	—	30
133·5–135·5	3	14	27·5	11·5	—	56
135·5–137·5	7	30·5	32·5	9	2	81
137·5–139·5	3	31	63·5	26·5	2	126
139·5–141·5	13	81	93	47·5	2	236·5
141·5–143·5	17	91·5	126·5	43	3	281
143·5–145·5	20	105	135·5	53·5	4	318
145·5–147·5	18	105	145	51	4	323
147·5–149·5	16	112·5	126	41	2	297·5
149·5–151·5	18	68	103·5	34	3	226·5
151·5–153·5	11	53	52·5	23·5	1	141
153·5–155·5	4·5	24	42·5	9·5	—	80·5
155·5–157·5	2	17·5	16	4	1	40·5
157·5–159·5	2	6	11·5	3	—	22·5
159·5–161·5	—	2	3	2	—	7
Totals	139·5	758	1008·5	372	27	2305

TABLE LII.

Head Breadth in mm.	Girls' Health					
	Very Robust	Robust	Norm-ally Healthy	Rather Delicate	Very Deli-cate	Totals
112·5–114·5	—	0·5	1	—	—	1·5
114·5–116·5	—	1·5	—	—	2	3·5
116·5–118·5	—	2	1	1·5	—	4·5
118·5–120·5	1	1	4·5	3·5	0·5	10·5
120·5–122·5	2	4	4·5	4·5	1	16
122·5–124·5	—	1·5	10·5	2	—	14
124·5–126·5	1·5	5·5	7·5	5·5	—	20
126·5–128·5	1·5	5·5	9	7·5	1	24·5
128·5–130·5	2	8·5	28·5	12·5	—	51·5
130·5–132·5	7·5	28	38·5	15	1	90
132·5–134·5	8·5	28·5	40·5	30·5	5	113
134·5–136·5	7	37	56	37	3	140
136·5–138·5	14·5	68·5	93·5	67·5	5·5	249·5
138·5–140·5	17	91·5	117	45	6	276·5
140·5–142·5	19	103	113	61·5	5·5	302
142·5–144·5	14·5	90·5	101·5	66	7	279·5
144·5–146·5	13·5	67·5	81	42	4	208
146·5–148·5	11·5	61	72·5	35	3	183
148·5–150·5	7·5	33	34·5	21	3·5	99·5
150·5–152·5	5	8·5	13	10	0·5	37
152·5–154·5	1	6	9·5	5·5	—	22
154·5–156·5	1	1	4·5	1	1	8·5
156·5–158·5	0·5	1·5	1	—	1	4
158·5–160·5	0·5	—	1	1	—	2·5
Totals	136·5	655·5	843·5	475	50·5	2161

APPENDIX. *Tables of Data* (*continued*).

Health and Auricular Height of Head

TABLE LIII.

Head Height in mm.	Boys' Health					
	Very Robust	Robust	Normally Healthy	Rather Delicate	Very Delicate	Totals
103·5–105·5	—	—	0·5	—	—	0·5
105·5–107·5	—	1	1·5	1	—	3·5
107·5–109·5	—	1	3	2	—	6
109·5–111·5	0·5	1·5	9·5	4	—	15·5
111·5–113·5	0·5	4	9	4	—	17·5
113·5–115·5	0·5	11	15	6	0·5	33
115·5–117·5	8	22	36	18·5	1·5	86
117·5–119·5	8	36·5	49·5	24	1	119
119·5–121·5	5	53·5	75·5	25	1	160
121·5–123·5	10·5	67	88·5	31	4·5	201·5
123·5–125·5	13·75	85·25	106·5	43·5	0·5	249·5
125·5–127·5	13·75	96·75	129·75	40·25	2	282·5
127·5–129·5	20	83·5	112·75	50·25	6	272·5
129·5–131·5	22	101·5	108	43·5	2·5	277·5
131·5–133·5	15	55·5	95	25·5	1·5	192·5
133·5–135·5	2	55	58	21·5	1	137·5
135·5–137·5	5	35	40·5	16	2	98·5
137·5–139·5	7	28	26·5	7	2	70·5
139·5–141·5	3	14·5	24·5	6	1	49
141·5–143·5	3·5	10·5	11·5	3	—	28·5
143·5–145·5	2·5	1·5	7·5	1	—	12·5
145·5–147·5	—	0·5	—	2	—	2·5
Totals	140·5	765	1008·5	375	27	2316

TABLE LIV.

Head Height in mm.	Girls' Health					
	Very Robust	Robust	Normally Healthy	Rather Delicate	Very Delicate	Totals
102·5–104·5	—	—	—	1	—	1
104·5–106·5	—	0·5	2	1	1	4·5
106·5–108·5	2	2·5	5·5	—	—	10
108·5–110·5	1	12	9·5	11	2	35·5
110·5–112·5	2	9	13·5	5·5	5	35
112·5–114·5	0·5	20	31	23	4	78·5
114·5–116·5	6·5	23	32	28	7	96·5
116·5–118·5	10·5	34	59	38	2	143·5
118·5–120·5	6·5	69·5	85	37·5	5	203·5
120·5–122·5	20	81·5	107	61	4	273·5
122·5–124·5	15	80	113	58	11	277
124·5–126·5	20	94	87·5	56·5	3	261
126·5–128·5	13·5	73	98·5	57	4	246
128·5–130·5	6	52	69·5	33·5	4·5	165·5
130·5–132·5	6	44	51	27	2	130
132·5–134·5	7·5	29·5	41	16	—	94
134·5–136·5	8	29	24	10	2	73
136·5–138·5	3	9	15	5	1	33
138·5–140·5	—	8	10	6	3	27
140·5–142·5	—	4	3	5	—	12
142·5–144·5	1	1	5	4	—	11
144·5–146·5	—	1	3	2	—	6
Totals	129	676·5	865	486	60·5	2217

Health and Cephalic Index

TABLE LV.

Cephalic Index	Boys' Health					
	Very Robust	Robust	Normally Healthy	Rather Delicate	Very Delicate	Totals
60–62	—	—	—	—	—	—
62–64	—	—	—	—	—	—
64–66	—	—	—	—	—	—
66–68	—	—	—	—	—	—
68–70	—	2	2·5	3	—	7·5
70–72	1·5	11	10·5	8·5	1	32·5
72–74	4·5	32	44	21·5	3	105
74–76	16	85	117	42·5	2	262·5
76–78	31	174	233·5	68·5	3	510
78–80	47·5	205·5	262·5	97	8	620·5
80–82	25	140	182	65	5	417
82–84	12·5	73	106·5	51·5	2	245·5
84–86	5·5	26	52·5	11	0·5	95·5
86–88	—	11	16·5	5·5	1	34
88–90	—	2·5	6	0·5	—	9
90–92	—	1	1	—	—	2
Totals	143·5	763	1034·5	374·5	25·5	2341

TABLE LVI.

Cephalic Index	Girls' Health					
	Very Robust	Robust	Normally Healthy	Rather Delicate	Very Delicate	Totals
60·5–62·5	—	0·5	0·5	1	—	2
62·5–64·5	1	1·5	7	2	—	11·5
64·5–66·5	1	2	3	3·5	2	11·5
66·5–68·5	1	3·5	6·5	5	—	16
68·5–70·5	3	5·5	19	10·5	2·5	40·5
70·5–72·5	2·25	20·75	37·5	16	3	79·5
72·5–74·5	7·25	46·25	54	35	3	145·5
74·5–76·5	17·5	89·5	111·5	60·5	9·5	288·5
76·5–78·5	29·5	154·5	194·5	115·5	12	506
78·5–80·5	25·5	164	214	104·5	14·5	522·5
80·5–82·5	26·5	105	128·5	85·5	5	350·5
82·5–84·5	16·5	49	69·5	36	4	175
84·5–86·5	4	18·5	30	21	3	76·5
86·5–88·5	1	5	7·5	3	1	17·5
88·5–90·5	1	3	5	2	—	11
90·5–92·5	—	—	—	—	—	—
Totals	137	668·5	888	501	59·5	2254

Appendix. *Tables of Data* (*continued*).

Athletic Power and Popularity with other Characters

Table Number	Sex		Character	Athletic Power				Popularity				Table Number
				Athletic	Betwixt	Non-Athletic	Totals	Popular	Betwixt	Unpopular	Totals	
LVII	Boys	Conscientiousness	Keen	664	27	289	980	881	172	50	1103	LXIX
			Betwixt	118	23	93	234	107	144	7	258	
			Dull	279	9	131	419	177	91	95	363	
			Totals	1061	59	513	1633	1165	407	152	1724	
LVIII	Girls		Keen	557	27	374	958	868	178	66	1112	LXX
			Betwixt	88	11	82	181	92	100	19	211	
			Dull	155	6	178	339	197	62	103	362	
			Totals	800	44	634	1478	1157	340	188	1685	
LIX	Boys	Self-consciousness	Self-conscious	455	14	200	669	530	130	78	738	LXXI
			Betwixt	93	18	68	179	98	102	4	204	
			Unself-conscious	461	25	220	706	618	141	68	827	
			Totals	1009	57	488	1554	1246	373	150	1769	
LX	Girls		Self-conscious	368	24	283	675	508	178	110	796	LXXII
			Betwixt	58	6	50	114	61	50	6	117	
			Unself-conscious	385	17	293	695	658	118	64	840	
			Totals	811	47	626	1484	1227	346	180	1753	
LXI	Boys	Self-assertion	Self-assertive	408	16	106	530	441	98	73	612	LXXIII
			Betwixt	148	21	80	249	140	124	9	273	
			Shy	483	20	324	827	649	179	72	900	
			Totals	1039	57	510	1606	1230	401	154	1785	
LXII	Girls		Self-assertive	297	17	142·5	456·5	430·5	72	92·5	595	LXXIV
			Betwixt	109	12	68	189	106	93	8	207	
			Shy	395	15	392·5	802·5	683·5	178	82·5	944	
			Totals	801	44	603	1448	1220	343	183	1746	

Table Number	Sex		Character	Athletic Power				Popularity				Table Number
				Athletic	Betwixt	Non-Athletic	Totals	Popular	Betwixt	Unpopular	Totals	
LXIII	Boys	Temper	Quick	241·5	15	77	333·5	246·5	81	35	362·5	LXXV
			Good-natured	764·5	36·5	386·5	1187·5	1012	247	54·5	1313·5	
			Sullen	120	6·5	84·5	211	104·5	65	73·5	243	
			Totals	1126	58	548	1732	1363	393	163	1919	
LXIV	Girls		Quick	192·5	5	96·5	294	156·5	49·5	47·5	253·5	LXXVI
			Good-natured	583	33·5	469·5	1086	1004·5	232·5	64	1301	
			Sullen	121·5	7	122·5	251	117	73	83·5	273·5	
			Totals	897	45·5	688·5	1631	1278	355	195	1828	
LXV	Boys	Vivacity (noise)	Noisy	436	22	89	547	467	74	76	617	LXXVII
			Betwixt	104	10	47	161	84	97	5	186	
			Quiet	604	31	419	1054	807	240	80	1127	
			Totals	1144	63	555	1762	1358	411	161	1930	
LXVI	Girls		Noisy	349	19	119	487	409	64	81	554	LXXVIII
			Betwixt	89	11	37	137	93	48	4	145	
			Quiet	451	16	532	999	846	246	114	1206	
			Totals	889	46	688	1623	1348	358	199	1905	
LXVII	Boys	Handwriting	Very Good	94	1	28·5	123·5	101	19·5	11	131·5	LXXIX
			Good	367·5	20·5	131·5	519·5	427·5	116	33	576·5	
			Moderate	388	24·5	233·5	646	474	173·5	69·5	717	
			Poor	115	10	82·5	207·5	136·5	62	30	228·5	
			Bad	25·5	—	19	44·5	19	9	8·5	36·5	
			Very Bad	4	1	9	14	9	6	—	15	
			Totals	994	57	504	1555	1167	386	152	1705	
LXVIII	Girls		Very Good	57	1	35	93	78	10	11	99	LXXX
			Good	277	9	186·5	472·5	449·5	87	33	569·5	
			Moderate	288	20	228·5	536·5	417·5	114	66	597·5	
			Poor	86	9	104	199	123	45	38	206	
			Bad	21	3	17	41	19	16	9	44	
			Very Bad	6	—	4	10	8	2	5	15	
			Totals	735	42	575	1352	1095	274	162	1531	

APPENDIX. *Tables of Data (continued).*

Athletic Power and Popularity with other Characters

Table Number	Sex		Character	Athletic Power				Popularity				Table Number
				Athletic	Betwixt	Non-Athletic	Totals	Popular	Betwixt	Unpopular	Totals	
LXXXI	Boys	Hair Colour	Red	60	2	21·5	83·5	66	8·5	7	81·5	LXXXIX
			Fair	387·5	25·5	196·5	609·5	477·5	144·5	41·5	663·5	
			Brown	390·5	34	193	617·5	465	141·5	56	662·5	
			Dark	318	21·5	118·5	458	331·5	112	49·5	493	
			Jet Black	15	3	11·5	29·5	23	4·5	8	35·5	
			Totals	1171	86	541	1798	1363	411	162	1936	
LXXXII	Girls		Red	51·5	3	19	73·5	58	11·5	14·5	84	XC
			Fair	320·5	16	241	577·5	514·5	126	67	707·5	
			Brown	366	13	296	675	548	127	76·5	751·5	
			Dark	193·5	14	143	350·5	272·5	73·5	44	390	
			Jet Black	4·5	—	7	11·5	14	3	2	19	
			Totals	936	46	706	1688	1407	341	204	1952	
LXXXIII	Boys	Hair Set	Smooth	885·5	57	442·5	1385	1003·5	340·5	123·5	1467·5	XCI
			Wavy	151	15·5	67	233·5	152	52	23·5	227·5	
			Curly	38·5	1·5	20·5	60·5	44·5	15·5	8	68	
			Totals	1075	74	530	1679	1200	408	155	1763	
LXXXIV	Girls		Smooth	540	32·5	447·5	1020	777·5	218·5	119	1115	XCII
			Wavy	222	9·5	145	376·5	417	71·5	41	529·5	
			Curly	109	3	80·5	192·5	141·5	42	24	207·5	
			Totals	871	45	673	1589	1336	332	184	1852	

Table Number	Sex		Character	Athletic Power				Popularity				Table Number
				Athletic	Betwixt	Non-Athletic	Totals	Popular	Betwixt	Unpopular	Totals	
LXXXV	Boys	Eye Colour	Light	436·5	27·5	222	686	522·5	142	56·5	721	XCIII
			Medium	471·5	44·5	246	762	539·5	177	73·5	790	
			Dark	254	14	101	369	259	88	41	388	
			Totals	1162	86	569	1817	1321	407	171	1899	
LXXXVI	Girls		Light	300	17·5	240·5	558	465·5	108	63·5	637	XCIV
			Medium	427	19·5	304·5	751	588·5	174·5	89	852	
			Dark	203	9	158	370	303	74·5	46·5	424	
			Totals	930	46	703	1679	1357	357	199	1913	
LXXXVII	Boys	Popularity	Popular	835	24	245	1104	—	—	—	—	
			Betwixt	143·5	23	187·5	354	—	—	—	—	
			Unpopular	69	3	58	130	—	—	—	—	
			Totals	1047·5	50	490·5	1588	—	—	—	—	
LXXXVIII	Girls		Popular	640	16	337	993	—	—	—	—	
			Betwixt	126	17	165	308	—	—	—	—	
			Unpopular	58	5	87	150	—	—	—	—	
			Totals	824	38	589	1451	—	—	—	—	

PRINTED IN GREAT BRITAIN BY THE SYNDICS OF THE PRESS
AT THE CAMBRIDGE UNIVERSITY PRESS

BIOMETRIC LABORATORY PUBLICATIONS.

Drapers' Company Research Memoirs.

Biometric Series.

I. **Mathematical Contributions to the Theory of Evolution.—XIII.** On the Theory of Contingency and its Relation to Association and Normal Correlation. By Karl Pearson, F.R.S. *Price* 5*s. net.*

II. **Mathematical Contributions to the Theory of Evolution.—XIV.** On the Theory of Skew Correlation and Non-linear Regression. By Karl Pearson, F.R.S. *Price* 5*s. net.*

III. **Mathematical Contributions to the Theory of Evolution.—XV.** On the Mathematical Theory of Random Migration. By Karl Pearson, F.R.S., with the assistance of John Blakeman, M.Sc. *Price* 5*s. net.*

IV. **Mathematical Contributions to the Theory of Evolution.—XVI.** On Further Methods of Measuring Correlation. By Karl Pearson, F.R.S. *Price* 5*s. net.*

V. **Mathematical Contributions to the Theory of Evolution.—XVII.** On Homotyposis in the Animal Kingdom. A Cooperative Study. [*In preparation*

VI. **Albinism in Man.** By Karl Pearson, E. Nettleship, and C. H. Usher. Text, Part I, and Atlas, Part I. *Price* 35*s. net.*

VII. **Mathematical Contributions to the Theory of Evolution.—XVIII.** On a Novel Method of Regarding the Association of two Variates classed solely in Alternative Categories. By Karl Pearson, F.R.S. *Price* 5*s. net.*

VIII. **Albinism in Man.** By Karl Pearson, E. Nettleship, and C. H. Usher. Text, Part II, and Atlas, Part II. *Price* 30*s. net.*

IX. **Albinism in Man.** By Karl Pearson, E. Nettleship, and C. H. Usher. Text, Part IV, and Atlas, Part IV. *Price* 21*s. net.*

X. **A Monograph on the Long Bones of the English Skeleton.** By Karl Pearson, F.R.S., and Julia Bell, M.A. Part I. Section I. *The Femur.* Text and Atlas of Plates. *Price* 30*s. net.*

XI. **A Monograph on the Long Bones of the English Skeleton.** By Karl Pearson, F.R.S., and Julia Bell, M.A. Part I. Section II. *The Femur of the Primates.* Text and Atlas of Plates. *Price* 40*s. net.*

XII. **On the Sesamoids of the Knee-Joint.** By Karl Pearson, F.R.S., and Adelaide G. Davin, B.Sc. (Reprinted from *Biometrika.*) Text and 37 Plates. *Price* 30*s. net.*

Studies in National Deterioration.

I. **On the Relation of Fertility in Man to Social Status, and on the Changes in this Relation that have taken place in the last 50 years.** By David Heron, M.A., D.Sc. *Price* 8*s. net.* Sold only with complete sets.

II. **A First Study of the Statistics of Pulmonary Tuberculosis (Inheritance).** By Karl Pearson, F.R.S. *Price* 8*s. net.* Sold only with complete sets.

III. **A Second Study of the Statistics of Pulmonary Tuberculosis.** Marital Infection. By Ernest G. Pope, revised by Karl Pearson, F.R.S. With an Appendix on Assortative Mating by Ethel M. Elderton. *Price* 5*s. net.*

IV. **On the Relationship of Health to the Psychical and Physical Characters in School Children.** By Karl Pearson, F.R.S. *Price* 15*s. net.*

V. **On the Inheritance of the Diathesis of Phthisis and Insanity.** A Statistical Study based upon the Family History of 1,500 Criminals. By Charles Goring, M.D., B.Sc. *Price* 4*s. net.*

VI. **A Third Study of the Statistics of Pulmonary Tuberculosis.** The Mortality of the Tuberculous and Sanatorium Treatment. By W. P. Elderton, F.I.A., and S. J. Perry, A.I.A. *Price* 4*s. net.*

VII. **On the Intensity of Natural Selection in Man.** (On the Relation of Darwinism to the Infantile Death-rate.) By E. C. Snow, D.Sc. *Price* 4*s. net.*

VIII. **A Fourth Study of the Statistics of Pulmonary Tuberculosis.** The Mortality of the Tuberculous. Sanatorium and Tuberculin Treatment. By W. Palin Elderton, F.I.A., and Sidney J. Perry, A.I.A. *Price* 4*s. net.*

IX. **A Statistical Study of Oral Temperatures in School Children with special reference to Parental, Environmental and Class Differences.** By M. H. Williams, M.B., Julia Bell, M.A., and Karl Pearson, F.R.S. *Price* 6*s. net.*

X. **Study of the Data provided by a Baby-Clinic in a large Manufacturing Town.** By Mary Noel Karn and Karl Pearson, F.R.S. *Price* 15*s. net.*

Technical Series.

I. **On a Theory of the Stresses in Crane and Coupling Hooks with Experimental Comparison with Existing Theory.** By E. S. Andrews, B.Sc. Eng., and Karl Pearson, F.R.S. *Price* 4*s. net.*

II. **On some Disregarded Points in the Stability of Masonry Dams.** By L. W. Atcherley, assisted by Karl Pearson, F.R.S. *Price* 7*s. net.* Sold only with complete sets.

III. **On the Graphics of Metal Arches with special reference to the Relative Strength of Two-pivoted, Three-pivoted and Built-in-Metal Arches.** By L. W. Atcherley and Karl Pearson, F.R.S. *Price* 5*s. net.*

IV. **On Torsional Vibrations in Axles and Shafting.** By Karl Pearson, F.R.S. *Price* 6*s. net.*

V. **An Experimental Study of the Stresses in Masonry Dams.** By Karl Pearson, F.R.S., and A. F. Campbell Pollard, assisted by C. W. Wheen, B.Sc. Eng., and L. F. Richardson, B.A. *Price* 7*s. net.*

VI. **On a Practical Theory of Elliptic and Pseudo-elliptic Arches, with special reference to the ideal Masonry Arch.** By Karl Pearson, F.R.S., W. D. Reynolds, B.Sc. Eng., and W. F. Stanton, B.Sc. Eng. *Price* 6*s. net.*

VII. **On the Torsion resulting from Flexure in Prisms with Cross-Sections of Uni-axial Symmetry only.** By Andrew W. Young, E. M. Elderton and Karl Pearson, F.R.S. *Price* 7*s.* 6*d. net.*

Questions of the Day and of the Fray.

I. **The Influence of Parental Alcoholism on the Physique and Ability of the Offspring.** A Reply to the Cambridge Economists. By Karl Pearson, F.R.S. *Price* 1*s.* 6*d. net.*

II. **Mental Defect, Mal-Nutrition, and the Teacher's Appreciation of Intelligence.** A Reply to Criticisms of the Memoir on 'The Influence of Defective Physique and Unfavourable Home Environment on the Intelligence of School Children.' By David Heron, D.Sc. *Price* 1*s.* 6*d. net.*

III. **An Attempt to correct some of the Misstatements made by Sir Victor Horsley, F.R.S., F.R.C.S., and Mary D. Sturge, M.D., in their Criticisms of the Memoir 'A First Study of the Influence of Parental Alcoholism.'** By Karl Pearson, F.R.S. *Price* 1*s.* 6*d. net.*

IV. **The Fight against Tuberculosis and the Death-rate from Phthisis.** By Karl Pearson, F.R.S. [*Out of print*

V. **Social Problems: Their Treatment, Past, Present and Future.** By Karl Pearson, F.R.S. *Price* 1*s.* 6*d. net.*

VI. **Eugenics and Public Health.** Lecture to the York Congress of the Royal Sanitary Institute. By Karl Pearson, F.R.S. *Price* 1*s.* 6*d. net.*

VII. **Mendelism and the Problem of Mental Defect. I.** A Criticism of Recent American Work. By David Heron, D.Sc. (Double Number.) *Price* 2*s. net.*

VIII. **Mendelism and the Problem of Mental Defect. II.** The Continuity of Mental Defect. By Karl Pearson, F.R.S., and Gustav A. Jaederholm, Ph.D. *Price* 1*s.* 6*d. net.*

IX. **Mendelism and the Problem of Mental Defect. III.** On the Graduated Character of Mental Defect, and on the need for standardizing Judgments as to the Grade of Social Inefficiency which shall involve Segregation. By Karl Pearson, F.R.S. (Double Number.) *Price* 2*s. net.*

X. **The Science of Man; Its Present Needs and Future Prospects.** Address to Section H, British Association 1920. By Karl Pearson, F.R.S. *Price* 1*s.* 6*d. net.*

XI. **Francis Galton, A Centenary Appreciation.** With portrait sketch. By Karl Pearson, F.R.S. *Price* 2*s. net.*

Tracts for Computers.

I. **The Digamma and Trigamma Functions (to assist the summation of series in products of inverse linear factors).** By Eleanor Pairman, M.A. *Price 3s. net.*

II. **On the Construction of Tables and on Interpolation. Part I.** Uni-variate Tables. By Karl Pearson, F.R.S. *Price 3s. 9d. net.*

III. **On the Construction of Tables and on Interpolation. Part II.** Bi-variate Tables. By Karl Pearson, F.R.S. *Price 3s. 9d. net.*

IV. **Facsimile Reissue of Legendre's Γ-Function Tables.** *Price 3s. 9d. net.*

V. **Table of the Coefficients of Everett's Central-Difference Interpolation Formula.** By A. J. Thompson, B.Sc. *Price 3s. 9d. net.*

VI. **Smoothing.** By E. C. Rhodes, B.A. *Price 3s. 9d. net.*

VII. **On the Evaluation of the Incomplete B-Function.** By H. E. Soper, M.A. *Price 3s. 9d. net.*

VIII. **Table of the Logarithms of the Complete Γ-Function, for Argument 2 to 1200 beyond Legendre's Range.** By Egon S. Pearson, B.A. *Price 3s. 9d. net.*

IX. **Table of Log Γ (x) from x = 1 to 50·9 by intervals of ·01.** By John Brownlee, M.D., D.Sc. *Price 3s. 9d. net.*

The Chances of Death and other Studies in Evolution

By KARL PEARSON, F.R.S.

GALTON PROFESSOR, UNIVERSITY OF LONDON

Vol. I.

1. The Chances of Death. 2. The Scientific Aspect of Monte Carlo Roulette. 3. Reproductive Selection. 4. Socialism and Natural Selection. 5. Politics and Science. 6. Reaction. 7. Woman and Labour. 8. Variation in Man and Woman.

Vol. II.

9. Woman as Witch. Evidences of Mother-Right in the Customs of Mediaeval Witchcraft. 10. Ashiepattle, or Hans seeks his Luck. 11. Kindred Group Marriage. Part I. Mother Age Civilisation. Part II. General Words for Sex and Kinship. Part III. Special Words for Sex and Relationship. 12. The German Passion Play: A Study in the Evolution of Western Christianity.

Reissue. *Price 30s. net.*

The Life, Letters, and Labours of Francis Galton

By KARL PEARSON, F.R.S.

GALTON PROFESSOR, UNIVERSITY OF LONDON

Vol. I. Birth 1822 to Marriage 1853. (Vol. II in Preparation)

With 5 pedigree plates and 72 photographic plates, frontispiece and 2 text-figures

Price of Vol. I 30s. net.

"It is not too much to say of this book that it will never cease to be memorable. Never will man hold in his hands a biography more careful, more complete."—*The Times*

"A monumental tribute to one of the most suggestive and inspiring men of modern times."—*Westminster Gazette*

"It was certainly fitting that the life of the great exponent of heredity should be written by his great disciple, and it is gratifying indeed to find that he has made of it what may without exaggeration be termed a great book."—*Daily Telegraph*

Tables for Statisticians and Biometricians

Edited by KARL PEARSON, F.R.S.

GALTON PROFESSOR, UNIVERSITY OF LONDON

Price 15s. net.

"To the workers in the difficult field of higher statistics such aids are invaluable. Their calculation and publication was therefore as inevitable as the steady progress of a method which brings within grip of mathematical analysis the highly variable data of biological observation. The immediate cause for congratulation is, therefore, not that the tables have been done but that they have been done so well……The volume is indispensable to all who are engaged in serious statistical work."—*Science*

"The whole work is an eloquent testimony to the self-effacing labour of a body of men and women who desire to save their fellow scientists from a great deal of irksome arithmetic; and the total time that will be saved in the future by the publication of this work is, of course, incalculable……To the statistician these tables will be indispensable."—*Journal of Education*

Just Issued, *Price 7s. 6d. net.* **Revised Baby Charts (Male and Female) for Weight and Health.** The Charts are mounted for hanging on the walls of 'Baby Welcome' or 'Infant Welfare' Centres, or they may be used for plotting the growth of Infants, and testing whether they are maintaining their grade.

The following works prepared in the Biometric Laboratory can be obtained as Government Publications from H.M. Stationery Office or through any Bookseller.

The English Convict. A Statistical Study. By Charles Goring, M.D. Text. *Price 9s.* Tables of Measurements (printed by Convict-Labour). *Price 5s.*

The English Convict. An Abridgement. By Charles Goring, M.D. With a preface by Karl Pearson, F.R.S. *Price 3s.*

Tables of the Incomplete Γ-Function. Prepared by the Computing Staff, Biometric Laboratory, and edited with an Introduction by Karl Pearson, F.R.S. *Price £2. 2s.*